(9)

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-353594
(43)Date of publication of application : 19.12.2000

(51)Int.Cl. H05B 33/22
G02B 5/20
G09F 9/00
G09F 9/30
G09F 9/33
H01L 33/00
H05B 33/10
H05B 33/12
H05B 33/14

(21)Application number : 2000-076979
(22)Date of filing : 17.03.1999

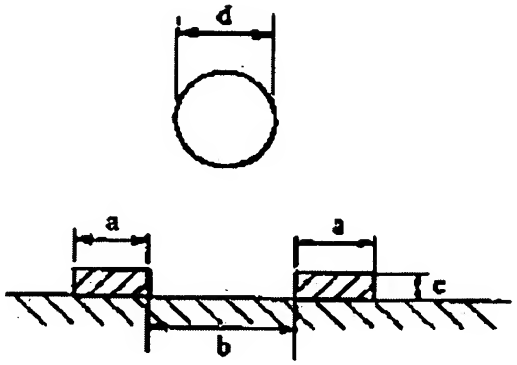
(71)Applicant : SEIKO EPSON CORP
(72)Inventor : SEKI SHUNICHI
KIGUCHI HIROSHI
YUDASAKA KAZUO
MIYAJIMA HIROO

(30)Priority

Priority number	Priority date	Priority country
10067508	17.03.1998	JP
11032123	10.02.1999	JP

(54) BOARD FOR PATTERNING THIN FILM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a display device such as an EL element and an LED element and a color filter presenting an extremely small variation in a film thickness for individual pixels in forming an organic semiconductor film and a thin film mad of a colored resin or the like.
SOLUTION: A thin film element has a thin film layer formed with an ink jet method on an area subject to boating partitioned by a bank with a prescribed height on a board. The bank is formed on the board satisfying the conditions that a>d/4, d/2<b<5d, c>t0 (t0 is a film thickness of the thin film layer), and c>d/(2b) where (a) is a width of the bank, (c) is a height of the bank, and (d) is a drop diameter of a liquid material forming the thin film layer. The bank is formed with an organic material on a bank forming surface constituted with an inorganic material, a plasma processing is conducted under an excessive fluorine condition with fluorine base gas as introduction gas, and the thin film material liquid is filled in the area surrounded by the bank to form the thin film layer. An fluorine base gas plasma processing is applied to the base having the bank formed with the organic material after an oxygen gas plasma processing.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] In the substrate for thin film patterning by which the coated field divided by the predetermined bank and this predetermined bank of height which are used in order to carry out patterning formation of the thin film by the ink-jet method was formed on the field When setting to d (micrometer) the diameter of an ink-jet drop of the liquid material which sets width of face of the aforementioned bank to a (micrometer), sets the height to c (micrometer), and sets width of face of the aforementioned coated field to b (micrometer), and forms a thin film layer, The substrate for thin film patterning characterized by forming the aforementioned bank so that <(d/2) b<5d may be satisfied.
[Claim 2] It is a substrate for thin film patterning according to claim 1 about the aforementioned bank being formed so that a> (d/4) may be satisfied further.
[Claim 3] The aforementioned bank is c>t0 further. [t0 (micrometer) is a substrate for thin film patterning according to claim 1 or 2 characterized by being formed so that thickness] of a thin film layer may be satisfied.
[Claim 4] The claim 1 characterized by forming the aforementioned bank so that c>d/(2b) may be satisfied further, or the substrate for thin film patterning of three given in any 1 term.
[Claim 5] The claim 1 characterized by the thing of the aforementioned bank for which the upper surface is formed with the organic substance at least, or the substrate for thin film patterning of four given in any 1 term.
[Claim 6] The claim 1 characterized by forming the upper surface and the side of the aforementioned bank with the organic substance, or the substrate for thin film patterning of four given in any 1 term.
[Claim 7] The aforementioned bank is the claim 1 characterized by being formed by two-layer [of a lower layer inorganic substance and the upper organic substance], or the substrate for thin film patterning of four given in any 1 term.
[Claim 8] The aforementioned bank is a substrate for thin film patterning according to claim 7 which is formed by two-layer [of a lower layer inorganic substance and the upper organic substance], and is characterized by the thing of this inorganic substance for which the side at least is not worn with this organic substance.
[Claim 9] The claim 1 characterized by the aforementioned coated field being an inorganic substance, or the substrate for thin film patterning of eight given in any 1 term.
[Claim 10] The claim 1 which has drop ****** on the up upper surface of the aforementioned bank, or the substrate for thin film patterning of nine given in any 1 term.
[Claim 11] The claim 5 which performed surface treatment so that the contact angle of the front face of the aforementioned coated field [as opposed to 20 degrees - 50 degrees and the aforementioned thin film liquid material in the contact angle to the inorganic substance front face in which the contact angle on the front face of the organic substance which forms the aforementioned bank forms 50 degrees or more and this bank] might become 30 degrees or

less, or the substrate for thin film patterning of ten given in any 1 term.
[Claim 12] The substrate for thin film patterning according to claim 11 characterized by performing the aforementioned surface treatment by plasma treatment.
[Claim 13] The thin film formation method which carries out patterning formation of the thin film by the ink-jet method using the substrat for thin film patterning given in a claim 1 or any 1 term of 12.
[Claim 14] The thin film formed by the thin film formation method according to claim 13.
[Claim 15] The thin film according to claim 14 which is an organic EL element to which patterning of the organic thin film which has red, green, or the luminescent color by which blue shell selection was carried out was carried out independently.
[Claim 16] The thin film according to claim 14 which is the light filter to which patterning of the organic thin film which penetrates only red, green, or the luminescent color by which blue shell selection was carried out was carried out independently.
[Claim 17] Display equipped with the thin film of 16 a claim 14 or given in any 1 term.
[Claim 18] Electronic equipment for a display which comes to have display according to claim 17 and a circuit apparatus to this display.
[Claim 19] The substrate for thin film patterning characterized by forming the front face of this bank with the organic substance at least, and forming the aforementioned coated field with the inorganic substance in the substrate for thin film patterning by which the coated field divided by the predetermined bank and this predetermined bank of height which are used in order to carry out patterning formation of the thin film by the dipping method or the spin coat method was formed on the field.
[Claim 20] The substrate for thin film patterning characterized by forming the upper surface and the side of the aforementioned bank with the organic substance, and forming the aforementioned coated field with the inorganic substance in the substrate for thin film patterning by which the coated field divided by the predetermined bank and this predetermined bank of height which are used in order to carry out patterning formation of the thin film by the dipping method or the spin coat method was formed on the field.
[Claim 21] It is the substrate for thin film patterning characterized by forming the aforementioned bank by two-layer [of a lower layer inorganic substance and the upper organic substance] in the substrate for thin film patterning by which the coated field divided by the predetermined bank and this predetermined bank of height which are used in order to carry out patterning formation of the thin film by the dipping method or the spin coat method was formed on the field, and forming the aforementioned coated field with the inorganic substance.
[Claim 22] It is the substrate for thin film patterning according to claim 21 characterized by the thing of the lower layer inorganic substance in the aforementioned bank for which the side at least is not worn with the aforementioned organic substance.
[Claim 23] The claim 19 which performed surface treatment so that the contact angle of the front face of the aforementioned coated field [as opposed to 20 degrees - 50 degrees and the aforementioned thin film liquid material in the contact angle to the inorganic substance front face in which the contact angle on the front face of the organic substance which forms the aforementioned bank forms 50 degrees or more and this bank] might become 30 degrees or less, or the substrate for thin film patterning of 22 given in any 1 term.
[Claim 24] The substrate for thin film patterning according to claim 23 characterized by performing the aforementioned surface treatment by plasma treatment.
[Claim 25] The thin film formation method which carries out patterning formation of the thin film by the dipping method or the spin coat method using the substrate for thin film patterning given in a claim 19 or any 1 term of 24.
[Claim 26] The thin film formation method according to claim 25 that the surface tension of the liquid material used for the aforementioned dipping method or the spin coat method is the value of 30 or less dyne/cm.

[Claim 27] The thin film formed by the thin film formation method according to claim 25 or 26.
[Claim 28] Display which comes to have a thin film according to claim 27.
[Claim 29] Electronic equipment for a display which comes to have display according to claim 28 and an electronic circuitry to this display.
[Claim 30] The thin film formation method which is characterized by providing the following and which fills up with thin-film-material liquid the field surrounded on the bank, and forms a thin film layer in it The bank formation process which forms the aforementioned bank in the bank forming face which consists of inorganic material by the organic material The surface-treatment process to which the aforementioned organic material performs the aforementioned surface treatment to the aforementioned bank and the aforementioned bank forming face under fixed conditions to which the grade of non-compatibility over the aforementioned thin-film-material liquid becomes higher compared with the aforementioned inorganic material when predetermined surface treatment is performed, and the thin film stratification process which fills up with the aforementioned thin-film-material liquid the field surrounded on the bank where the aforementioned surface treatment was carried out, and form a thin film layer in it
[Claim 31] The aforementioned surface treatment is the thin film formation method according to claim 30 which is the reduced pressure plasma treatment which uses the gas which contained the fluorine or the fluorine compound in introductory gas, and carries out plasma irradiation under reduced pressure atmosphere.
[Claim 32] The aforementioned surface treatment is the thin film formation method according to claim 30 which is the atmospheric pressure plasma treatment which uses the gas which contained the fluorine or the fluorine compound in introductory gas, and carries out plasma irradiation under atmospheric pressure atmosphere.
[Claim 33] The aforementioned fixed conditions are the thin film formation method according to claim 31 or 32 on condition of there being more fluorine system compounds than oxygen.
[Claim 34] The aforementioned fixed conditions are the thin film formation method according to claim 33 that the content of a fluorine system compound and the fluorine system compound to the total amount of oxygen is set up to 60% or more.
[Claim 35] The gas containing the aforementioned fluorine or the fluorine compound is the thin film formation method according to claim 31 or 32 of using the halogen gas of CF4, SF6, and CHF3 grade.
[Claim 36] The thin film formation method according to claim 30 that the conditions of the aforementioned surface treatment are set up so that the contact angle to the aforementioned bank forming face of the aforementioned thin-film-material liquid may become 20 or less degrees.
[Claim 37] The thin film formation method according to claim 30 that the conditions of the aforementioned surface treatment are set up so that the contact angle to the aforementioned bank forming face of the aforementioned thin-film-material liquid may become 50 degrees or more.
[Claim 38] The aforementioned bank formation process is the thin film formation method according to claim 30 which forms the aforementioned bank by the upper layer and the lower layer bilayer.
[Claim 39] The aforementioned bank formation process is the thin film formation method [equipped with the lower layer film formation process which forms a lower layer film in the aforementioned bank forming face, the upper formation process which form the upper layer according to th formation field of the aforementioned bank on the aforementioned lower layer film, and the removal process which ********** and remove the aforementioned lower layer film of the field in which the upper layer concerned is not prepared by using the aforementioned upper layer as a mask] according to claim 38.
[Claim 40] The aforementioned bank formation process is the thin film formation method according to claim 38 which sets the lower layer film concerned to the formation field of an

aforementioned bank lower layer by the lower layer film formation process which forms a lower layer film in the aforementioned bank forming face, and aligns exposure, the process develop, the upper film formation process which covers the aforementioned lower layer and form the upper film, and the upper film concerned with the formation field of the aforementioned bank upper layer, and it has in exposure and the process develop.

[Claim 41] The aforementioned surface treatment is the thin film formation method according to claim 38 which the compatibility over the aforementioned thin-film-material liquid of the aforementioned bank lower layer is less than [it of the aforementioned pixel electrode], and is what is set up more than it of the aforementioned bank upper layer.

[Claim 42] The thin film formation method according to claim 38 that the conditions of the aforementioned surface treatment are set up so that a contact angle may become [the front face of the aforementioned bank upper layer] 50 degrees or more to the aforementioned thin-film-material liquid.

[Claim 43] The thin film formation method according to claim 38 that the conditions of the aforementioned surface treatment are set up so that the front face of the aforementioned bank lower layer may become the range whose contact angle is 20 degrees or 40 degrees to the aforementioned thin-film-material liquid.

[Claim 44] It is the thin film formation method according to claim 30 to 43 which is an organic semiconductor material for a pixel electrode being prepared in the field surrounded on the aforementioned bank, and the aforementioned thin-film-material liquid forming a thin film light emitting device.

[Claim 45] The aforementioned pixel electrode is the thin film formation method according to claim 44 which is an ITO electrode layer.

[Claim 46] The aforementioned bank is the thin film formation method according to claim 30 which is an insulating organic material.

[Claim 47] The aforementioned bank lower layer is the thin film formation method according to claim 38 which is either a silicon oxide, a silicon nitride or an amorphous silicon.

[Claim 48] Display manufactured by the thin film formation method indicated by any 1 term of a claim 30 or a claim 47.

[Claim 49] The surface-treatment method which is the surface-treatment method of the substrate for filling up with thin-film-material liquid the field surrounded on the bank formed on the substrate, and equipped the substrate in which the bank was formed with the first process which performs oxygen gas plasma treatment, and the second process which performs fluorine system gas plasma treatment after this after the first process of the above.

[Claim 50] The surface-treatment method according to claim 49 characterized by the plasma treatment of either the first process of the above and the second process being the atmospheric pressure plasma processed under atmospheric pressure at least.

[Claim 51] The surface-treatment method according to claim 49 characterized by the plasma treatment of either the first process of the above and the second process being the reduced pressure plasma processed under reduced pressure at least.

[Claim 52] The surface-treatment method which is the surface-treatment method for filling up with thin-film-material liquid the field surrounded on the bank formed on the substrate, and equipped the substrate in which the bank was formed with the process which performs fluorine system gas plasma treatment.

[Claim 53] The surface-treatment method according to claim 52 characterized by the aforementioned plasma treatment being the reduced pressure plasma processed under reduced pressure.

[Claim 54] The surface-treatment method given in the claim 49 characterized by the aforementioned substrate being an inorganic substance, or any 1 term of 53.

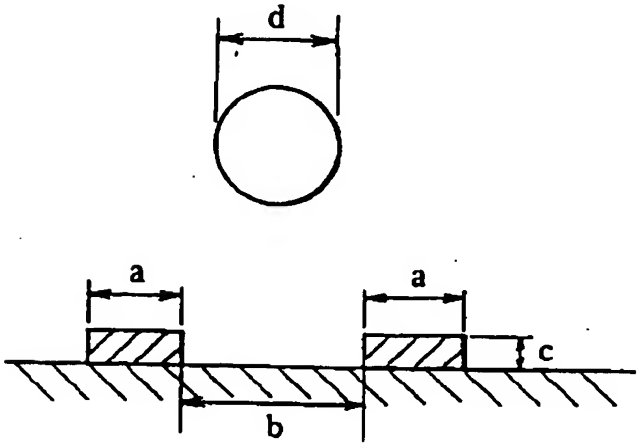
[Claim 55] The surface-treatment method given in the claim 49 characterized by forming the upper surface of this bank with the organic substance at least on the bank formed on the

aforementioned substrate, or any 1 term of 53.
[Claim 56] The surface-treatment method given in the claim 49 characterized by forming the upper surface and the side of this bank with the organic substance on the bank formed on the aforementioned substrate, or any 1 term of 53.
[Claim 57] It is the surface-treatment method given in the claim 49 characterized by formation, now being on the bank formed on the aforementioned substrate by two-layer [of the inorganic substance of a lower layer / bank / this], and the upper organic substance /, or any 1 term of 53.
[Claim 58] It is the surface-treatment method given in the claim 49 which this bank is formed by two-layer [of a lower layer inorganic substance and the upper organic substance] on the bank formed on the aforementioned substrate, and is characterized by the thing of this inorganic substance for which the side at least is not being worn with this organic substance, or any 1 term of 53.
[Claim 59] The surface-treatment method according to claim 54 which carries out the parent liquefaction of the substrate front face which consists of the aforementioned inorganic substance to the aforementioned thin-film-material liquid.
[Claim 60] The surface-treatment method given in the claim 55 which ****** the organic substance front face which forms the aforementioned bank to the aforementioned thin-film-material liquid, or any 1 term of 58.
[Claim 61] The surface-treatment method according to claim 60 which changes the organic substance front face which forms the aforementioned bank Teflon (registered trademark).
[Claim 62] The surface-treatment method given in the claim 49 which carries out the parent liquefaction of the substrate front face which ****** the organic substance front face which forms the aforementioned bank to the aforementioned thin-film-material liquid, and consists of the aforementioned inorganic substance to the aforementioned thin-film-material liquid, or any 1 term of 61.
[Claim 63] The surface-treatment method according to claim 59 that the contact angle to the aforementioned substrate front face of the aforementioned thin-film-material liquid is 30 or less degrees.
[Claim 64] The surface-treatment method according to claim 60 that the contact angle to the organic substance front face which forms the aforementioned bank of the aforementioned thin-film-material liquid is 50 degrees or more.
[Claim 65] The surface-treatment method according to claim 62 that the contact angle to the organic substance front face in which the contact angle to the aforementioned substrate front face of the aforementioned thin-film-material liquid is 30 or less degrees, and forms the aforementioned bank is 50 degrees or more.
[Claim 66] The surface-treatment method given in the claim 49 whose contact angle to the organic substance front face in which the contact angle to the lower layer front face in which the contact angle to the aforementioned substrate front face of the aforementioned thin-film-material liquid forms the aforementioned bank 30 or less degrees forms the aforementioned bank upper layer 50 degrees from 20 degrees is 50 degrees or more, or any 1 term of 65.
[Claim 67] The thin film formation method equipped with the process which fills up with thin-film-material liquid the field surrounded on the bank formed on the substrate, and fills up immediately with the aforementioned thin-film-material liquid the field surrounded on the bank of a substrate where it is the method of forming a thin film, and the surface-treatment method of a publication was given to the claim 49 or any 1 term of 66 with an ink-jet method after the surface treatment concerned.
[Claim 68] The thin film formation method equipped with the process which fills up with thin-film-material liquid the field surrounded on the bank formed on the substrate, and fills up immediately with the aforementioned thin-film-material liquid the field surrounded on the bank

of a substrate where it is the method of forming a thin film, and the surface-treatment method of a publication was given to the claim 49 or any 1 term of 66 by the spin coat method or the dipping method after the surface treatment concerned.
[Claim 69] The thin film equipped with the thin film formed by the thin film formation method according to claim 67 or 68.
[Claim 70] Display equipped with the structure of having the thin film formed by the thin film formation method according to claim 67 or 68, as a light filter.
[Claim 71] Display equipped with the structure of having the thin film formed by the thin film formation method according to claim 67 or 68, as an organic EL element.
[Claim 72] The manufacture method of the thin film which forms a thin film by the thin film formation method according to claim 67 or 68.
[Claim 73] The manufacture method of the thin film according to claim 69 which forms a thin film by the thin film formation method according to claim 67 or 68, and makes this a light filter.
[Claim 74] The manufacture method of a thin film according to claim 72 that the aforementioned thin film is an organic EL element.
[Claim 75] That a flat-surface configuration is circular or the substrate for thin film patterning according to claim 1 which is the ellipse form of the portion surrounded on the aforementioned bank.
[Claim 76] A thin film patterning substrate with the annular configuration of opening formed of this bank in the substrate for thin film patterning which has the bank of the configuration of a predetermined pattern on a substrate and this substrate.
[Claim 77] That a configuration is circular or the substrate for patterning according to claim 76 which is the ellipse form of the aforementioned annular opening.
[Claim 78] An EL element with the annular configuration of opening formed in the field surrounded by the predetermined bank and this predetermined bank of a configuration of a pattern of this bank in the EL element which has a luminescent-material thin film on the substrate and this substrate.
[Claim 79] That a configuration is circular or the EL element according to claim 78 which is the ellipse form of the aforementioned annular opening.
[Claim 80] The surface-treatment method of a substrate of having the process which performs a series of surface-treatment processings on all the substrate front faces on which it is the surface-treatment method of the substrate for being filled up with thin film formation material, and the bank was formed in the field surrounded on the bank prepared on the substrate uniformly, and raises the non-compatibility over the thin film formation material of a bank section front face to them to it of the front face of the portion between banks by this processing of a series of.

[Translation done.]

Drawing selection [Repr sentative drawing]



[Translation done.]

JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] The substrate for thin film patterning and its surface treatment this invention relate to the thin film coating technology suitable for manufacture of the display, such as EL (electroluminescence) element and a Light Emitting Diode (light emitting diode) element, or the light filter which used the organic-semiconductor film.
[0002] It is related with the substrate for carrying out patterning membrane formation of the thin film from which properties, such as a full color organic EL (electroluminescence) element and a light filter, differ especially on the same substrate, the thin film formation method, and a thin film. Moreover, that it is easy to form a thin film layer with an ink-jet method, a flat thin film layer can be formed and it is related with the thin film formation method which needs detailed patterning. Furthermore, it is related with the display equipped with the surface-treatment method for carrying out patterning restoration of the thin-film-material liquid with high definition on the ink-jet method or a spin coat, the method of forming a thin film using this surface-treatment method, and this thin film to the field surrounded on the bank formed on the substrate, and its manufacture method.
[0003]
[Description of the Prior Art] In recent years, the thin film from which a property differs in the same substrate is formed by the predetermined pattern by application, and the technology in which it obtains a functional device is developed. Formation of a different thin film pattern on the same substrate is made by the ink-jet method as the leading method. However, in the case where an ink-jet method is used, the problem in the process side that a different thin film material on a substrate is mixed arises. Although the technology which paints thin film materials, such as an organic semiconductor material in display, such as an EL element, and a coloring resin in a light filter, using an ink-jet method is specifically used, when it is filled up with liquid material using an ink-jet method and forms the pattern of a thin film, the problem of flowing into the pixel which the breathed-out liquid material adjoins has arisen.
[0004] The convex batch member (called a "bank" or "heights") into which a different thin film field is usually divided is prepared to such a problem, and the method filled up with the liquid material used as a thin film which is different to the field surrounded by this batch member is taken. In the example of the above-mentioned display device, the batch member into which each coloring matter field is divided is prepared, and the method of filling up the field surrounded in each batch field with the material which constitutes a pixel is taken.
[0005] generally in the latest functional device, especially display, thinness requires -- having -- a batch -- in spite of restricting the height of a member according to it, the field surrounded by the batch member is far filled up with a lot of liquid material as compared with the volume after film production

[0006] for this reason, the size of th drop breathed out by the field surrounded by the batch member and a batch -- a member -- a problem arises from the unsavoriness of balance with the area of the field surrounded by a front face and this This problem is explained below.
[0007] a batch -- a member -- it should be filled up -- a thin film material -- it is -- a liquid -- material -- receiving -- a lyophilic -- or -- wettability -- having -- if -- a case -- a diaphragm -- it is -- even if -- a diaphragm -- pulling -- having -- the field of a request in a final thin film to which liquid material adjoins easily if thickness cannot be obtained and the amount of liquid material is made [many] -- flowing out .
[0008] On the other hand, the front face of the field surrounded by the diaphragm needs to have high compatibility and wettability to liquid material so that liquid material may get wet uniformly in this and it may spread. Otherwise, to the field surrounded by the batch member, liquid material will get wet, and will not spread, but the color omission and irregular color in a pixel will arise in a display device like especially an EL element.
[0009] such a problem -- receiving -- JP,9-203803,A and JP,9-230129,A -- a batch -- the technology which makes the upper part of a member liquid repellance, and carries out surface treatment so that the other portion may become lyophilic is proposed
[0010] these conventional examples -- both -- a batch -- the layer which forms in the upper surface of a member the layer (the layer which consists of a fluorine compound) which consists of a liquid repellance material, and shows non-compatibility to JP,9-203803,A -- a batch -- it apply to the upper part of a member , the technology process the front face of the field surrounded by the batch member with a hydrophilic radical surfactant be indicate , and the technology which make compatibility the crevice further surrounded by UV irradiation by the batch member be indicate by JP,9-230129,A The logical consideration is indicated by International Display ResearchConference 1997 and pp 238-241.
[0011] however, it can set on the aforementioned conventional technology -- as -- a batch -- a member, though the lyophilic of the field surrounded by liquid repellance on top and the batch member is realized to some extent For example, when applying liquid material using an ink-jet method the size of the drop breathed out, and the above-mentioned batch -- a member -- extremely large to the area of the field surrounded by a front face and this -- it is -- it is -- when these balance was remarkable and bad, a coated field was not correctly filled up with liquid material, but the bird clapper understood it that patterning with a high precision is impossible that it was small etc. if the size of for example, the above-mentioned drop changes too much more greatly than the field surrounded by the batch member -- a drop -- a batch -- a member -- a top -- running aground -- further -- a batch -- a member -- when an up front face is narrow, a drop will overflow to the field contiguous to the coated field made into the purpose
[0012] Thus, when the relation between the size of a drop and the area of the field surrounded by a batch member and this is not aptitude, dispersion in thickness will be produced for every mixture of the thin-film-material liquid between the fields which originated in the above problems and were surrounded by the batch member, or thin film to form.
[0013] Moreover, in case the field divided by the batch member is filled up with a thin film material, a problem is also further produced about the compatibility over the thin-film-material liquid of a diaphragm.
[0014] The behavior of the thin-film-material liquid with which the field surrounded by the batch member or the batch member was filled up with what wettability (compatibility) is shown to thin-film-material liquid differs. it mentioned already -- as -- a batch -- if the front face of a member shows compatibility (hydrophilic property) to thin-film-material liquid -- a batch -- when filled up with the material of the amount exceeding the height of a member, even if there is a batch member, thin-film-material liquid will flow into the field surrounded by the batch member which adjoins easily conversely, a batch -- if the front face of a member shows non-compatibility (water repellence) moderately to thin-film-material liquid -- a batch -- even

if filled up with the material of the amount exceeding the height of a member, thin-film-material liquid does not flow into the field surrounded by the surface tension of material by the next batch member

[0015] In order to acquire a specific property as reforming on the more concrete front face of a substrate And manufacture of the light filter of the front face concerned, For example, JP,9-203803,A, JP,9-230129,A which were mentioned already, furthermore, the thing indicated by JP,9-230127,A -- that is The technology of being the method of carrying out ** ink processing of the bank front face with a fluorine system compound, and processing the field surrounded on a bank with the surfactant which has a hydrophilic radical (JP,9-203803,A), Parent ink processing is raised by the method (JP,9-230127,A) of processing by etching, or energy irradiation (JP,9-230129,A).

[0016] however -- especially -- fluorine system compound material -- using -- a member -- when making a front face into ** ink nature, or when forming a member using fluorine system compound material, adhesion with the ground layer or ground substrate which forms the aforementioned fluorine system material and a member becomes bad, and when application is considered to the technology which forms a bank on a substrate, there is a problem Moreover, there is a possibility that a residue may arise to a bank field and the parent ink nature on the front face of a bank may be spoiled, after patterning by photo lithography though a member, especially the bank itself are able to be formed with the fluorine system compound material of ** ink nature etc.

[0017] moreover -- the above-mentioned well-known technology -- a batch -- a member -- only in order to make the upper part into non-compatibility, the application of the material which shows non-compatibility, dryness, removal, etc. could not but be needed, and the number of processes could not but increase Moreover, in performing UV irradiation, there is an inclination which serves as compatibility with much material. Even if material was non-compatibility material, it came to produce compatibility a little by UV irradiation, and there was an inclination for non-compatibility processing of **** to become useless. Although the purport which controls the grade of compatibility by irradiating ultraviolet rays from both sides of the front reverse side was especially specified to JP,9-230129,A, about how the contact angle to control of the compatibility of non-compatibility and compatibility, for example, thin-film-material liquid, is set up, respectively, it was unknown.

[0018] moreover, a batch -- case the liquid repellance of a member is strong -- a batch -- since the liquid of a thin film material is crawled by the side attachment wall of a member, the thickness after membrane formation becomes it is thick and thin in the center section of the field surrounded by the batch member at a periphery Now, the irregular color in a pixel arises in a display device. It leads to the fall of reliability that it is especially easy to produce short-circuit in an EL element.

[0019] a batch, when **** processing is performed on the surface of a member and compatibility (lyophilic) is given to the side although there is nothing with a bird clapper thinly around the field where the thin film material was offered and the thickness after membrane formation was surrounded by the batch member -- the great portion of liquid of a thin film material -- a batch, since it is pulled by the side of a member Thickness not only becomes larger in the skirt portion of a thin film, i.e., the portion which touches a substrate, but a bird clapper does not have control of thickness as it is difficult.

[0020] As the reforming method of the surface energy (wettability) of an organic substance, performing plasma treatment is known well. As such a surface-treatment method, there are some which are indicated by JP,63-308920,A, for example. The surface-treatment method indicated by this official report controls the surface energy of the aforementioned organic substance by processing an organic substance front face using the mixed-gas plasma containing fluorine system gas and oxygen gas, and changing the mixing ratio of the aforementioned mixed gas.

[0021] Moreover, in order to hydrophilicity-ize inorganic substance front faces, such as glass and ITO (Indium Tin Oxide), it is the technique by which how to carry out UV irradiation and oxygen plasma treatment was also learned well.
[0022] However, when preparing the pattern of the layer which consists of the organic substance or an inorganic substance on the same substrate, the technology which controls the wettability of each material by plasma treatment or UV irradiation simple and strictly in this substrate is not reported. the member formed with an organic substance front face or the organic substance of mixed-gas plasma treatment -- by the method of giving ** ink nature to a front face, when surface ** ink nature is transient, it passes like a heat process or time passes [**** / that ** ink nature cannot be given efficiently], there is a problem that ** ink nature deteriorates
[0023] Moreover, it is difficult for there to be a possibility of spoiling the ** ink nature on the front face of a bank, and to attain simultaneously the ** ink nature on the front face of a bank, and the parent ink nature on the front face of a bank by energy irradiation, when performing parent ink processing.
[0024] Thus, in the method of supplying a different thin film material, filling up with thin-film-material liquid the field surrounded by the method of forming the thin film of a predetermined pattern, especially the batch member (bank) formed on the substrate, and forming a thin film, it is important to control appropriately the wettability (** ink nature and parent ink nature) of a bank and a crevice. If there is no ** ink nature in a bank, when being filled up with thin-film-material liquid which is different in the crevice which it not only produces an ink residue, but adjoins across a bank on a bank, thin-film-material liquid which overcomes this bank and is different will be mixed mutually. If such a case arises, the thin film which has a desired property cannot be formed.
[0025] Although a color organic EL element, the light filter used for a liquid crystal display are mentioned as an example which forms a thin film using thin-film-material liquid which is different on the other hand in the crevice which adjoins across a bank, when manufacturing these, the field, i.e., ITO and glass-substrate front face, top which a bank is ** ink nature and are surrounded on a bank must be parent ink nature. If there is no parent ink nature in a crevice, the wetting breadth within a pixel will cause a color omission and thickness nonuniformity bad.
[0026] Furthermore, by the above-mentioned method, in addition to ** ink processing, parent ink down stream processing of a pixel field, i.e., a crevice, is needed, and it has the difficulty that the things and the process that control of the ink to supply is difficult will increase, further.
[0027] this invention is finished under such a situation. When carrying out patterning membrane formation of the thin film from which a property differs on the same substrate, a thin-film-material liquid prevents the situation of flowing out across a bank, and this invention can form certainly the thin film layer of the stable property without the irregular color of flatness and uniform thickness etc. with the sufficient yield highly precise comparatively easily, and sets it as the main purposes to make high definition detailed patterning possible.
[0028] In case the 1st purpose of this invention forms thin films, such as an organic semiconductor material and a coloring resin, with regurgitation methods, such as an ink-jet method and a bubble jet (registered trademark) method, it is to offer thin films to which mixture in every thin film field did not take place, but patterning of the dispersion in thickness was carried out with high precision remarkably few, such as an organic EL element and a light filter. Moreover, this purpose is accompanied and this invention also makes it the purpose to offer the substrate for thin film patterning with which manufacturing this thin film is presented, the display equipped with this thin film, and th thin film formation method for obtaining this thin film further.
[0029] Furthermore, in case the 2nd purpose of this invention forms electric conduction thin films, such as wiring of a semiconductor device, an electron device, etc., by the spin coat method or the dipping method, it is to offer the substrate thin film which makes still more

detailed patterning possible, the thin film formation method, the thin film formed by this method, the display equipped with this thin film, and electronic equipment equipped with this display, respectively.

[0030] The 3rd purpose of this invention is offering a display device and display equipped with the surface-treatment method of the substrate the bank's aiming at wettability simple and suitable control having been formed, the method of forming a thin film using this surface-treatment method, and this thin film, and these manufacture methods.

[0031] The bank itself is offering the thin film formation method which can control the compatibility of a bank and a bank forming face certainly in the 4th purpose of this invention managing plasma treatment on fixed conditions, without passing through many processes for compatibility control, maintaining high adhesion with a bank forming face. It is this preventing thin-film-material liquid flowing out across a bank, raising the yield, and decreasing a manufacturing cost.

[0032] The 5th purpose of this invention is offering the display which can prevent thin-film-material liquid flowing out across a bank, and has the thin film layer of uniform thickness by setting up the compatibility of a bank and a bank forming face certainly by managing plasma treatment on fixed conditions. It is being able to perform by this image display which produces unevenness neither in a luminosity nor a color, and raising reliability.

[0033]

[Means for Solving the Problem] In the thin film formation using the regurgitation method as stated above in order that this invention persons may attain the 1st purpose of the above, as a result of repeating research wholeheartedly the above-mentioned batch to liquid material -- a member -- it not only adjusts the lyophilic of the field surrounded by surface liquid repellance and the batch member, but with the size of the drop of the liquid material breathed out further a batch -- by optimizing a relation with the area of the field surrounded by the member and this batch member, it finds out that the 1st purpose of the above-mentioned this invention can be attained

[0034] Moreover, in addition to wettability control of the field surrounded by the aforementioned diaphragm and diaphragm to liquid material, in the thin film formation using the spin coat method or the dipping method, it finds out that the 2nd purpose of the above-mentioned this invention can be attained by adjusting the surface tension of this liquid material to a specific value. this invention is completed based on this knowledge.

[0035] In order to attain the 1st purpose of the above, this invention Namely, the bank of height predetermined to a substrate top, And it is the display device formed in the thin film patterning substrate which forms the pattern of a thin film layer in the coated field divided by this bank by the ink-jet method, or this patterning substrate. When setting to d (micrometer) the diameter of a drop of the liquid material which sets width of face of the above-mentioned bank to a (micrometer), sets the height to c (micrometer), and sets width of face of a coated field to b (micrometer), and forms a thin film layer, the above-mentioned bank is characterized by having the following property.

[0036] (1) It is formed on a substrate and a bank becomes so that $d / 2 < b < 5d$ may be satisfied. By fulfilling this property range, liquid material does not run aground on a bank, but the color mixture in a pixel is prevented. Furthermore, at least one of the following properties is added to this property.

[0037] (2) $a > d/4$: If b becomes $a > d/4$ when small, although liquid material may run aground on a bank, mixture of the thin film material in a coated field will be prevented.

[0038] (3) $c > t0$ [t0 (micrometer) is thickness [of a thin film layer]].

(4) $c > d/(2b)$

In addition, although the above-mentioned parameters a and c become fixed in the case of a stripe or a square coated field, when a pixel is a circle, Parameter a is a curtate distance between pixels, and Parameter c becomes a diameter.

[0039] The bank of predetermined height where this invention for attaining the 2nd purpose of the above was formed on the substrate, In the thin film which is constituted and becomes so that it may have the coated field divided by this bank and the thin film layer formed in this field by the dipping method or the spin coat method Using the substrate by which predetermined surface treatment (wettability control) was made, surface tension forms the aforementioned thin film layer using the liquid material of 30 or less dyne/cm, and it is characterized by the bird clapper.
[0040] By making surface tension of liquid material into this range, formation of a patterning thin film is attained by the spin coat method or the dipping method by width of face of several microns or less.
[0041] In this invention, the thin film formation method for obtaining these thin films, the display equipped with this thin film as a display device, and electronic equipment equipped with this display are proposed further.
[0042] As what attains the purpose of the 3rd henceforth of the above, the invention concept common to invention which this invention person could make and which is mentioned later It is the surface-treatment method for filling up with thin film formation material the field surrounded in the substrate on the bank. A series of surface-treatment processings are uniformly performed on all the substrate front faces in which the bank was formed. The non-compatibility over the thin film formation material of a bank partial front face by this processing of a series of It is the display using display devices, such as an EL element using the surface-treatment technology of having the process raised to it of the front face of the portion between banks, the thin film coating technology using this surface-treatment technology, the thin film patterning substrate using this, or this, or this element.
[0043] As opposed to it giving the mask after OK and bank formation for the bank pattern by which surface treatment was carried out by carrying out patterning, and performing surface treatment, after the conventional example as stated above gives a water-repellent finish all over the photoresist top before patterning According to this this invention, as a series of processings are performed almost uniformly for the whole surface and the process of the different species [surface treatment] in the middle of surface treatment, such as plasma treatment, does not involve, the target surface treatment on the front face of a substrate which has the bank formed beforehand can be performed at a stretch. Here, a series of surface-treatment processings are processings which apply the below-mentioned plasma treatment to the substrate in which the bank which becomes the bank forming face which consisted of inorganic material from an organic material was formed at a stretch suitably like the after-mentioned.
[0044] Then, the bank formation process which forms a bank in the bank forming face which invention which attains the 3rd purpose of the above is the surface-treatment method for filling up with thin film formation material the field surrounded in the substrate on the bank, and consists of inorganic material by the organic material, When predetermined surface treatment is performed, a bank is characterized by having the surface treatment process which performs surface treatment to a bank and a bank forming face under fixed conditions to which the grade of non-compatibility over thin-film-material liquid becomes higher compared with a bank forming face.
[0045] Furthermore, the bank formation process which forms a bank in the bank forming face which other forms of this invention are the thin film formation methods which fill up with thin-film-material liquid the field surrounded on the bank, and form a thin film layer in it, and consists of inorganic material by the organic material, The surface treatment process to which a bank performs surface treatment to a bank and a bank forming face under fixed conditions to which the grade of non-compatibility over thin-film-material liquid becomes higher compared with a bank forming face when predetermined surface treatment is performed, It is characterized by having the thin film layer formation process which fills up with thin-film-material liquid the field surrounded on the bank where surface treatment was carried

out, and forms a thin film layer in it.
[0046] the batch which prepares in order to divide with a bank here as stated above (for example, the pixel of the display using the organic-semiconductor thin film), or is prepared in order to divide the pixel field of a light filter -- the thing of a member is said Even if a bank forming face is a field which prepares this bank and are drive substrates, such as display, they may be transparent substrates, such as a light filter, etc.
[0047] As surface treatment, the gas which contained the fluorine or the fluorine compound in introductory gas, for example is used, and the reduced pressure plasma treatment and atmospheric pressure plasma treatment which carry out plasma irradiation under reduced pressure atmosphere and atmospheric pressure atmosphere are performed. It is mentioned that plasma treatment is performed in the gas containing a fluorine system compound and oxygen as fixed conditions. Under these conditions, on the surface of inorganic material, an unreacted machine is generated by plasma electric discharge, an unreacted machine oxidizes by oxygen and polar groups, such as a carbonyl group and a hydroxyl group, occur. A polar group shows compatibility to the fluid containing polar molecules, such as water, and shows non-compatibility to the fluid containing the nonpolar molecule. The phenomenon in which a fluorine system compound molecule enters an organic material-list side in parallel to the above reactions also in an organic material-list side is also produced. When the content of a fluorine system compound and the fluorine system compound to the total amount of oxygen is set up to 60% or more when there are more especially fluorine system compounds than oxygen for example, since the mixing-ized phenomenon of a fluorine system compound prospers rather than the oxidation reaction by oxygen, by gas atmosphere-ization with the excessive amount of a fluorine system compound, a front face is un-polarized by the mixing-ized phenomenon rather than the influence by oxidation reaction. Therefore, when a fluorine system compound carries out plasma treatment of the organic material on excessive conditions, non-compatibility is shown to the fluid containing the polar molecule, and compatibility comes to be shown to the fluid containing the nonpolar molecule.
[0048] As gas containing the fluorine or the fluorine compound, the halogen gas of CF4, SF6, and CHF3 grade is used, for example. If surface treatment is performed under these conditions, the compatibility of the front face will be adjusted so that the contact angles to a fluid may differ greatly between an organic material and inorganic material. The conditions of surface treatment are set up so that the contact angle to the bank forming face of thin-film-material liquid may become 20 or less degrees with the above-mentioned surface treatment. Moreover, the conditions of surface treatment are set up so that the contact angle to the bank forming face of thin-film-material liquid may become 50 degrees or more. When a bank is formed by the bilayer, by surface treatment, the compatibility over the thin-film-material liquid of a bank lower layer is less than [it of a pixel electrode], and is set up more than it of the bank upper layer. For example, the conditions of surface treatment are set up so that a contact angle may become [the front face of the bank upper layer] 50 or less degrees to thin-film-material liquid. The conditions of surface treatment are set up so that the front face of a bank lower layer may become the range whose contact angle is 20 degrees or 40 degrees to thin-film-material liquid.
[0049] It is decided whether to be compatibility here or be non-compatibility by with what property the thin-film-material liquid with which it is filled up is equipped. For example, if it is thin-film-material liquid with a hydrophilic property, the front face which has a polar group shows compatibility, and the front face which has a nonpolar group shows non-compatibility. Conversely, if it is thin-film-material liquid with lipophilic property, the front face which has a polar group shows non-compatibility, and the front face which has a nonpolar group shows compatibility. for manufacture, it will boil variously as what a thin film material is used, it will change, and will apply
[0050] Preferably, a bank formation process forms a bank by the upper layer and the lower layer bilayer. This bank formation process is equipped with the lower layer film formation process

which forms a lower layer film in a bank forming face, the upper formation process which forms the upper layer according to the formation field of a bank on a lower layer film, and the removal process which **********s and removes the lower layer film of the field in which the upper layer concerned is not prepared by using the upper layer as a mask as an example.

[0051] Moreover, as another example, by setting the lower layer film concerned by the lower layer film formation process which forms a lower layer film in a bank forming face to the formation field of a bank lower layer, a bank formation process sets the upper film concerned by exposure, the process to develop, and the upper film formation process which covers a lower layer and forms the upper film to the formation field of the bank upper layer, and is equipped with exposure and the process to develop.

[0052] A pixel electrode is prepared in the field surrounded as an example of application on a bank, and the case where it is an organic semiconductor material for thin-film-material liquid forming a thin film light emitting device is mentioned. This is organic-semiconductor display. At this time, for example, a pixel electrode, it is an ITO electrode layer. As for a bank, specifically, it is desirable that they are insulating organic materials, such as a polyimide. Moreover, in preparing a bank lower layer, it uses a silicon oxide, a silicon nitride, or an amorphous silicon.

[0053] this invention which furthermore attains the 4th purpose of the above is the surface-treatment method for filling up with thin-film-material liquid the field surrounded on the bank formed on the substrate, and offers the surface-treatment method which equipped the substrate in which the bank was formed with the first process which performs oxygen plasma treatment, and the second process which performs fluorine system gas plasma treatment after this.

[0054] According to this method, the front face of inorganic substance substrates, such as glass and ITO, can be first made into a lyophilic (compatibility) to the aforementioned thin-film-material liquid by oxygen gas plasma treatment.

[0055] The oxygen plasma treatment performed at the first process of the above is effective in order to perform efficiently ****** by the fluorine system gas plasma treatment it not only carries out ashing of the residue at the time of forming a bank with the organic substance on a substrate, but continuously performed by activating an organic substance front face.

[0056] By performing fluorine system gas plasma treatment at the second process of the above, the fluoridation (Teflon-izing) of the organic substance front face is carried out, and it can give semipermanent liquid repellance to the organic substance. The lyophilic on a substrate is not spoiled by this fluorine system gas plasma treatment, and a lyophilic and a liquid repellance front face can be alternatively formed on the same substrate by the simple method.

[0057] Moreover, let plasma treatment of either the first process of the above, and the second process at least be the atmospheric pressure plasma processed under atmospheric pressure. Or let plasma treatment of either the first process of the above, and the second process at least be the reduced pressure plasma processed under reduced pressure.

[0058] Moreover, if the grade of contamination on a substrate is low, only fluorine plasma treatment is. With reduced pressure plasma, especially a substrate front face is washed and can Teflon-ize the organic substance which forms a bank.

[0059] The aforementioned substrate can consist of inorganic substances. The parent liquefaction of the substrate front face which consists of this inorganic substance can also be carried out.

[0060] On the bank formed on the aforementioned substrate, the upper surface of this bank can be formed with the organic substance at least. Or on the bank formed on the aforementioned substrate, the upper surface and the side of this bank can also be formed with the organic substance. On the bank formed on the aforementioned substrate, the bank concerned can also be formed by two-layer [of a lower layer inorganic substance and the upper organic substance] further again. Moreover, the bank concerned is formed by two-layer [of a lower layer inorganic substance and the upper organic substance], and even if there are few inorganic

substances concerned, it can avoid wearing the side with this organic substance on the bank formed on the aforementioned substrate.

[0061] Moreover, the organic substance front face which forms the aforementioned bank can be made into ****** (non-compatibility). And the organic substance front face which forms the aforementioned bank can also be Teflon-ized again. The parent liquefaction of the substrate front face which ****** the organic substance front face which forms the aforementioned bank further again, and consists of the aforementioned inorganic substance can also be carried out.

[0062] Since it is not necessary to use a liquid repellance material for the organic material which forms a bank from the first, the width of face of material selection spreads.

[0063] Moreover, surface energy (a lyophilic, liquid repellance) is easily controllable by conditions, such as the processing time, a kind of gas, a quantity of gas flow, plasma intensity, a plasma electrode, and substrate distance.

[0064] A contact angle [as opposed to the aforementioned bank front face for the contact angle to the aforementioned substrate front face of the aforementioned thin-film-material liquid] can be made 30 or less degrees at 50 degrees or more.

[0065] If the contact angle to the substrate front face of the aforementioned thin-film-material liquid exceeds 30 degrees, on the substrate surrounded on the bank, thin-film-material liquid will be uniformly [there are no whole surface ****** or] damp, and will not spread, but will produce thickness nonuniformity. On the other hand, thin-film-material liquid will adhere also to the bank upper part with a low from 50 degrees, or the contact angle to the aforementioned bank front face of the aforementioned thin-film-material liquid will flow out in the substrate which is pulled at a bank side and adjoins across a bank. That is, patterning to the place of a request of the aforementioned thin-film-material liquid will become impossible.

[0066] Moreover, by forming a bank from two-layer, using inorganic material for a lower layer, and controlling to become 20 - 50 degrees with a contact angle, or the film does not stick at the bank skirt, the problem which becomes thin is solvable.

[0067] Therefore, it becomes possible to carry out patterning of the thin-film-material liquid to the field surrounded by the above-mentioned surface-treatment method on the bank with high precision by the paint film methods, such as the ink-jet method or a spin coat. If the thin film forming method by the substrate and the ink-jet method for having performed the above-mentioned surface treatment is used, it will become possible to manufacture a full color organic EL element in a simple and light-filter row high definition at a low cost.

[0068] Furthermore, this invention which attains the 5th purpose fills up with thin-film-material liquid the field surrounded on the bank formed on the substrate, is the method of forming a thin film, and offers the thin film formation method equipped with the process which fills up immediately with the aforementioned thin-film-material liquid the field surrounded on the bank of a substrate where the surface treatment mentioned above was given with an ink-jet method after the surface treatment concerned.

[0069] Moreover, ** which attains the 5th purpose, and this invention fill up with thin-film-material liquid the field surrounded on the bank formed on the substrate, are the method of forming a thin film, and offer the thin film formation method equipped with the process which fills up immediately with the aforementioned thin-film-material liquid the field surrounded on the bank of a substrate where the surface treatment mentioned above was given by the spin coat method or the dipping method after the surface treatment concerned.

[0070] In order to attain the 5th purpose, this invention offers the display equipped with the thin film formed by the thin film formation method mentioned above further again. A bird clapper can do this display from a light filter and an organic EL element.

[0071] Moreover, this invention offers the manufacture method of the display which forms a thin film by the thin film formation method mentioned above in order to attain the 5th purpose.

[0072]

[Embodiments of the Invention] Below, the 1st which carried out invention of a claim according

to claim 1 to 29 - the 3rd example, and its modification are explained.
[0073] (1): The 1st example (mode using the ink-jet method)
In the display which has the thin film layer by which the display of this invention is formed in the substrate front face divided by the predetermined bank and this predetermined bank of height on the substrate by the ink-jet method When setting to d (micrometer) the diameter of a drop of the liquid material which sets width of face of the above-mentioned bank to a (micrometer), sets the height to c (micrometer), and sets to b (micrometer) width of face of the coated field divided into the above-mentioned bank, and forms a thin film layer, The above-mentioned bank is a>d/4, d / 2< b<5d, and c>t0. [t0 (micrometer) is formed on a substrate so that thickness [of a thin film layer]] and each formula of c>(1/2) x (d/b) may be satisfied.
[0074] Drawing 1 is a ** type view for explaining the relation of the bank and drop which were prepared in the substrate at the time of forming the display of this invention by the ink-jet method.
[0075] (a) Say the batch member prepared in order that the bank (called heights or a diaphragm) prepared on the substrate used for the display of the composition this invention of a bank may divide the pixel of the display using for example, the full color organic EL element, or the pixel field of a light filter. If width of face of the above-mentioned bank is set to a (micrometer) as shown in drawing 1 , the value is required when performing a uniform application, without it being full of the pixel field to which liquid material adjoins to the diameter d of a drop of the regurgitation liquid in the ink-jet method (micrometer) that it is a>d/4, i.e., a larger value than the quadrant of the diameter of a drop.
[0076] Although the height is prepared as c (micrometer) on a substrate, a bank The value is the thickness t0 of the thin film layer which it is going to form. (micrometer) When width of face of the below-mentioned large coated field is set to b (micrometer) It is desirable to prepare so that it may become c>(1/2) x (d/b), i.e., a larger value than 1/2 of the ratio of the diameter of a drop and the width of face of a coated field, when attaining the purpose of this invention. When it takes into consideration that as thin the one of surface element as possible is desirable, c is 2 microns or less.
[0077] In this invention, when liquid material overflows on the occasion of the application in the ink-jet method to the pixel field which adjoins when applying simultaneously the coloring matter or organic-semiconductor luminescent material of three colors of red, green, and blue, in order to avoid that color mixture arises, it is desirable to prepare predetermined ****** in a bank front face. A thing as the thing on the front face of up of a bank for which ****** is preferably prepared in a part for a center section in the shape of a slot is desirable and shows to drawing 2 as the configuration is illustrated. That is, although drawing 2 A - 2C is the cross section of the bank which has the above-mentioned ******, the cross section of drawing 2 A is the thing of a V character configuration, drawing 2 B is a concave-like thing, and drawing 2 C is the thing of U configuration or a semi-sphere configuration.
[0078] Though liquid material overflows from the target pixel in case it applies by the ink-jet method by preparing such ******, it is regarded by ******, and though a drop runs aground on a bank, it is similarly regarded by ******. Consequently, the color mixture of a display device is avoidable.
[0079] It is a member which functions as a batch member, ****** (Teflon-izing) by plasma treatment is possible for a bank, and its insulating organic materials, such as a polyimide which adhesion with a ground substrate is good and patterning by the photolithography tends to carry out, are desirable so that the material which shows liquid repellance to liquid material may be sufficient and it may mention later. A batch member may make a cover function make it serve a double purpose in a light filter. In order to form as a covered member, the material for black matrices uses metals and oxides, such as chromium.
[0080] Formation of a bank can b performed by arbitrary methods, such as the lithography method and print processes. For example, when using the lithography method, according to the

height of a bank, an organic material is applied by predetermined methods, such as a spin coat, a spray coat, a roll coat, a die coat, and a DIP coat, and a resist layer is applied on it. And it leaves the resist doubled with the bank configuration by giving a mask according to a bank configuration, and exposing and developing a resist. It **********s at the end and the bank material of portions other than a mask is removed. Moreover, you may form a bank (heights) above two-layer [by which the lower layer was constituted from an inorganic substance and the upper layer was constituted from the organic substance].

[0081] (b) The composition bank of a substrate is formed on a substrate. Although you may be the transparent substrate used for a light filter even if it is the drive substrate in which the TFT (TFT:Thin Film Transistor) used for display was formed as a substrate, it is desirable that the front face is formed by the member with high adhesion with a bank. It is desirable to consist of inorganic material especially at the point of acquiring suitable compatibility in the below-mentioned surface treatment. ITO(s) which are transparent electrodes as such a thing if it is display are glass, a quartz, etc. if it is a light filter, and it is **********.

[0082] (c) The display of the composition this invention of a coated field and a thin film layer has the substrate front face divided by the above-mentioned bank, i.e., the thin film layer which used liquid material for the coated field by the ink-jet method, and was formed in it. It is as [substrate / which forms the above-mentioned coated field] above-mentioned. In this invention, when setting to d (micrometer) the diameter of an ink-jet drop of the liquid material which forms a thin film layer, it is required to make width of face b of a coated field (micrometer) into the value of the range of d / 2< b<5d. When the values of b are below d/2 (micrometer), a drop is full of a coated field, and the problem of a drop running aground on a bank, even if it flows into the pixel field which adjoins through a bank or liquid repellance is in a bank arises. Moreover, when the value of b is more than 5d (micrometer), although it spreads to a coated field, in order for thickness to become thin and to obtain desired thickness, the overprint of multiple times is needed and uneconomical [a drop]. Moreover, depending on the case, it may get wet uniformly and may not spread.

[0083] In this invention, if the above-mentioned coated field has the above-mentioned size Although there is especially no limit about the configuration and any configurations, such as a square (a rectangle, a square, and a rhombus are included), polygons (five square shapes, six square shapes, etc.), and a configuration similar to annular configurations, such as being circular (a perfect circle form and an ellipse form being included), a cross, and these other, are possible In the application method by the ink-jet method, that to which it made this edge section the curved surface from the desirable thing that it is the configuration in which a drop tends to get wet in the thing of a configuration which has the edge section (for example, the corner and the vertex section in a square) especially is desirable. It can be made easy to wet the above-mentioned edge portion wet, when liquid material is filled up into a coated field with doing in this way.

[0084] Although liquid material is applied to the above-mentioned coated field and a thin film layer is prepared, as the example of application, there is organic EL display, in here, a thin film layer is a pixel electrode, and liquid material is an organic semiconductor material for forming a thin film light emitting device. In this case, for example, the above-mentioned pixel electrode, it is an ITO electrode layer.

[0085] (d) In a surface treatment this invention, it is desirable that a bank front face performs surface treatment to the substrate material of a bank and a coated field so that the grade of non-compatibility over liquid material may become higher compared with a coated field. It is desirable to make the contact angle to the bank front face of liquid material into 50 degrees or more with. such surface treatment, and to make the contact angle to the substrate material of a coated field into 20 or less degrees. Only a predetermined coated field is filled up without liquid material's overcoming a bank and overflowing, even if it breathes out a lot of liquid material by doing in this way compared with thin film layer thickness.

[0086] As the above-mentioned surface treatment, the gas which contains a fluorine or a fluorine compound in introductory gas, for example is used, and the reduced pressure plasma treatment and atmospheric pressure plasma treatment which carry out plasma irradiation under the reduced pressure atmosphere containing a fluorine compound and oxygen or atmospheric pressure atmosphere are mentioned. As gas containing a fluorine or a fluorine compound, CF4, SF6, and CHF3 grade are mentioned.
[0087] (e) In a thin film formation this invention, apply liquid material to the coated field divided on the above-mentioned bank by the ink-jet method, and form a thin film layer in it. By using the ink-jet method, restoration becomes possible with small equipment which can fill up liquid material into arbitrary coated fields with arbitrary amounts, and is used for a home printer. In this invention, by optimizing the configuration of the coated field divided into a bank and this bank, and a size to the path d of the drop breathed out (micrometer), color mixture with the next pixel does not happen, but a thin film layer without dispersion in the thickness for every pixel is obtained.
[0088] Discharge quantity in the ink-jet method is taken as an amount which becomes desired thickness, when volume decreases by heat-treatment after an application. You may carry out superposition processing after dryness so that it may become desired thickness by the case. Viscosity is usually Number cP making it breathe out from an ink-jet formula recording head.
[0089] A predetermined coated field will be filled up in this invention, without liquid material's overcoming a bank and overflowing, even if it breathes out a lot of liquid material by specifying the size of a bank, and the width of face of a coated field to the size of the breathed-out drop compared with thin film layer thickness. After being filled up with liquid material, in the case of the material containing a solvent, by performing heat-treatment and/or reduced pressure processing, and removing a solvent component, the volume of liquid material decreases and a thin film layer is formed in a coated field. At this time, since surface treatment of the front face, i.e., substrate front face, of a coated field is carried out so that a lyophilic may be shown as mentioned above, a thin film layer sticks it suitably. As a liquid material which can be used, as for the case of display, an organic semiconductor material can use the charge of a coloring matter etc. again, as for the case of a light filter. An organic luminescent material which has luminescence chosen from red, green, and blue as an organic semiconductor material, for example is used.
[0090] In addition, although all of ****** breathed out by gassing by heat can be used as an ink-jet method even if it is a piezo jet method, a piezo jet method is desirable at a point without deterioration of the fluid by heating.
[0091] (2): The 2nd example (mode using the dipping method or the spin coat method)
In the display with which this invention persons have the thin film layer which is divided by the predetermined bank and this predetermined bank of height, prepares a coated field, performs desired surface treatment, and is formed by the dipping method or the spin coat method on a substrate Also by the thin film formation method that the above-mentioned thin film layer is characterized by forming surface tension using the liquid material of 30 dyne/cm, it found out that the purpose of this invention was attained. Even if in addition to the surface energy of a bank and a substrate especially the above-mentioned display attains the above-mentioned purpose and compares it with the describing [above] ink-jet method by controlling the surface energy of liquid material, without adding limitation to the configuration or size of a bank or a coated field in any way unlike the case of the application which used the ink-jet method, it makes still more detailed patterning possible. by controlling in the range of the above-mentioned surface tension especially, it will be used effective in detailed patterning, such as metal wiring, and several micrometer piece patterning becomes possible Moreover, it is effective when using material with the hole-injection layer common to R, G, and B used for organic EL-element manufacture.
[0092] About the substrate used here, a bank, and coated field material, the quality of the

material is the same as that of the case of the application which used the describing [above] ink-jet method. Moreover, it is desirable to perform the surface treatment same to a bank front face and a coated field as the case of the ink-jet method. Therefore, as for the substrate which are a bank and a coated field, it is desirable respectively that it is what has the contact angle of 50 degrees or more and 30 degrees or less to liquid material. Each of the dipping method and the spin coat method can be performed by the method usually performed in this industry.

[0093] (3): The 3rd example (concrete operation gestalt of display)

The concrete composition of the display of this invention is explained below.

[0094] (Composition) Drawing 3 is the block diagram showing typically the layout of the whole active matrix type display in this operation gestalt. Drawing 4 is the plan showing one of the pixels in drawing 3 , a cross section [in / cutting plane A-A of drawing 4 / in respectively drawing 5 A - 5C], a cross section in cutting plane B-B, and a cross section in cutting plane C-C.

[0095] The active matrix type display of this operation gestalt equips a part for the center section of the transparent substrate 10 with the display 11. The data side drive circuit 3 and the scan side drive circuit 4 are established in the periphery portion of the transparent substrate 10, from the data side drive circuit 3, the data line sig is wired by the display 11 and the scanning line gate is wired from the scan side drive circuit 4. The complementary type TFT is constituted from these drive circuits 3 and 4 by TFT of N type and TFT of P type which are not illustrated. This complementary type TFT constitutes the shift register circuit, the level-shifter circuit, the analog switch circuit, etc., and constitutes the data signal and scanning signal which are supplied from the outside possible [power amplification].

[0096] Two or more pixels 7 are arranged on the transparent substrate 10 like the active matrix substrate of liquid crystal active matrix type display at the display 11. Two or more scanning lines gate and two or more data lines sig cross, the drive circuits 3 and 4 or ** is wired, and the data line sig and the scanning line gate of a lot are allotted to each pixel 7. The common feeder com other than the data line sig which crosses in the shape of a matrix, and the scanning line gate is wired through near which is each pixel.

[0097] Each pixel 7 is a bank (bank). It is formed in the circular crevice with a diameter of 50 micrometers surrounded in the layer. The width of face a is 10 micrometers, height is 2 micrometers, and the material of the bank layer which divides a pixel is as above-mentioned. Moreover, as a liquid material (what diluted the PPV precursor solution with DMF, the glycerol, and the diethylene glycol, and ink-ized it), organic semiconductor-material solutions, such as the poly (parlor phenylenevinylene) (PPV) precursor solution, are used. The organic-semiconductor film 43 is formed by breathing out and heating this liquid material to the coated field surrounded by the ink-jet method on the bank. Moreover, you may be the laminated structure which formed conductive material, such as polyethylene dioxythiophene, from the ink-jet method or the spin coat method as a hole-injection transporting bed.

[0098] Each pixel 7 is equipped with the flow control circuit 50 and the thin film light emitting device 40. The flow control circuit 50 is equipped with 1st TFT20, retention volume cap, and 2nd TFT30. As for 1st TFT20, the scanning signal is supplied to the gate electrode through the scanning line gate. Retention volume cap is constituted possible [maintenance of the picture signal supplied from the data line sig through 1st TFT20]. The picture signal by which 2nd TFT30 was held with retention volume cap is supplied to the gate electrode. The series connection of the 2nd TFT30 and thin film light emitting device 40 is carried out between Counterelectrode op and the common feeder com.

[0099] 1st TFT20 and 2nd TFT30 are formed with the island-like semiconductor film, as shown in drawing 4 and drawing 5 A - 5C. As for 1st TFT20, the gate electrode 21 is constituted as a part of scanning line gate. The data line sig is electrically connected to one side of the source drain field through the contact hole of an insulator layer 51 between the 1st layer, and, as for 1st TFT20, the drain electrode 22 is electrically connected to another side. As for the drain

electrode 22, the gate electrode 31 of 2nd TFT30 is electrically connected through the contact hole of an insulator layer 51 between the 1st layer. The relay electrode 35 by which simultaneous formation of 2nd TFT30 was carried out with the data line sig through the contact hole of an insulator layer 51 at one side of the source drain field between the 1st layer is connected electrically. The transparent electrode 41 of the thin film light emitting device 40 is electrically connected to the relay electrode 35 through the contact hole of an insulator layer 52 between the 2nd layer. ITO is used as a transparent electrode.

[0100] As for 2nd TFT30, the common feeder com is electrically connected to another side of the source drain field through the contact hole of an insulator layer 51 between the 1st layer. To the installation portion 36 of the gate electrode 31 of 2nd TFT30, the installation portion 39 of the common feeder com counters on both sides of an insulator layer 51 as a dielectric film between the 1st layer, and constitutes retention volume cap. In addition, about retention volume cap, you may form between the scanning line gate besides the above-mentioned structure formed between the common feeders com, and the capacity line formed in parallel. Moreover, you may constitute retention volume cap using the drain field of 1st TFT20, and the gate electrode 31 of 2nd TFT30.

[0101] The thin film light emitting device 40 surrounded in the bank layer is formed independently every pixel 7. The thin film light emitting device 40 carries out the laminating of the organic-semiconductor film 43 and the counterelectrode op to order as a luminescence thin film, and is formed in the upper layer side of the pixel electrode 41. As an organic-semiconductor film 43, the material which emits light by impression of electric field, for example, poly, (parlor phenylene) (PPV) is used. In addition, the organic-semiconductor film 43 is formed for every pixel, and also it may be formed in the stripe configuration over two or more pixels 7. Metal membranes, such as a conductive material which reflects light, for example, lithium content aluminum, and calcium, are used for Counterelectrode op. Counterelectrode op is formed in the field except the display 11 whole and the field in which the terminal 12 is formed at least.

[0102] In addition, you may adopt the structure in which the both sides of the structure which prepared the hole-injection layer as mentioned above, and raised luminous efficiency (hole-injection efficiency) as the above-mentioned thin film light emitting device 40, the structure which prepared the electron-injection layer and raised luminous efficiency (electron-injection efficiency), a hole-injection layer, and an electron-injection layer were formed.

[0103] (The manufacture method of display) Next, the manufacture method of the active matrix type display of the above-mentioned composition is explained.

[0104] Semiconductor stratification process: After forming the ground protective coat to which it is thin from the silicon oxide which is about 2000-5000A by the plasma CVD method to the transparent substrate 10 first if needed by making TEOS (tetrapod ethoxy silane), oxygen gas, etc. into material gas, the semiconductor film on which it is thin by the plasma CVD method from the amorphous silicon film which is about 300-700A is formed in the front face of a ground protective coat. Next, to the semiconductor film which consists of an amorphous silicon film, crystallization processes, such as laser annealing or a fixed grown method, are performed, and a semiconductor film is crystallized on a polysilicon contest film. Next, the gate insulator layer 37 to which patterning of the semiconductor film is carried out, and it considers as an island-like semiconductor film, and is thin by the plasma CVD method to the front face from the silicon oxide or nitride which is about 600-1500A by making TEOS (tetrapod ethoxy silane), oxygen gas, etc. into material gas is formed. Next, after forming the electric conduction film which consists of metal membranes, such as aluminum, a tantalum, molybdenum, titanium, and a tungsten, by the spatter, patterning is carried out, and the installation portions 36 of the gate electrodes 21 and 31 and the gate electrode 31 are formed. The scanning line gate is formed in this process.

[0105] In this state, high-concentration phosphorus ion is driven in and a source drain field is

formed in a self-adjustment target to the gate electrodes 21 and 31. In addition, the portion into which an impurity was not introduced serves as a channel field. Next, after forming an insulator layer 51 between the 1st layer, each contact hole is formed and the installation portions 39 of data-line sig, the drain electrode 22, the common feeder com, and the common feeder com and the relay electrode 35 are formed. Consequently, 1st TFT20, 2nd TFT30, and retention volume cap are formed.

[0106] Next, an insulator layer 52 is formed between the 2nd layer, and a contact hole is formed in the portion which is equivalent to this layer insulation film at the relay electrode 35. Next, after forming an ITO film in the whole front face of an insulator layer 52 between the 2nd layer, patterning is carried out, through a contact hole, it connects with the source drain field of 2nd TFT30 electrically, and the pixel electrode 42 is formed in it every pixel 7.

[0107] Insulator layer formation process: Next, an insulator layer 62 is formed along with the scanning line gate and the data line sig. An insulator layer 62 consists of organic insulating materials, such as the aforementioned polyimide. An insulator layer 62 chooses the value which optimized liquid material as the width of face and thickness to the diameter of a drop at the time of applying by the ink-jet method as mentioned above.

[0108] Surface treatment process: Plasma treatment is performed as mentioned above using the gas which subsequently contains a fluorine that an insulator layer 62 should be set for the front face of the pixel electrode 41 or more to 50 by non-compatibility, for example, a contact angle, to liquid material 20 or less to liquid material by compatibility (it is a hydrophilic property when liquid material contains moisture), for example, a contact angle.

[0109] Organic-semiconductor (organic EL element) film formation process: Form each organic-semiconductor film 43 corresponding to R, G, and B in the coated field divided by the circle configuration by the bank after the above-mentioned surface treatment using the ink-jet method. That is, the regurgitation of the liquid material which is the material for constituting the organic-semiconductor film 43 from an ink-jet formula recording head to the coated field of the circle configuration surrounded by the bank layer is carried out. As an example, the thing which doped coloring matter, such as a rhodamine and BERIREN, or the thing which ink-ized the PPV precursor (MHE-PPV) was used for what ink-ized the above-mentioned PPV precursor as a red luminous layer material. What dissolved in aromatic system solvents, such as a xylene, and ink-ized the poly fluorene derivative as a material for a blue luminous layer was used. The diameter of a drop was 30micrometerphi.

[0110] Subsequently, in the case of a PPV precursor solution (what carried out DMF dilution and ink-ized the PPV precursor solution), remove a solvent under reduced pressure, it is made to conjugate it by 150-degree Centigrade heat-treatment, is fixed to a coated field, and forms the organic-semiconductor film 43. here, since the size and configuration of a bank layer and a coated field are set as the value optimized to 30 micrometers of diameters phi of a drop of the liquid material breathed out, the application field of the organic-semiconductor film 43 is certainly prescribed by the bank layer, and it does not see and come out of it to the adjoining pixel 7 And since a bank layer has non-compatibility to liquid material and a coated field has compatibility to liquid material, liquid material does not adhere to a bank side attachment wall. Consequently, the organic-semiconductor film 43 formed after heat treatment holds uniform thickness on every pixel electrode and a pixel electrode.

[0111] In addition, what is necessary is just to repeat the restoration and dryness of liquid material by the ink-jet method for each class, in forming a multilayer-structure element, when carrying out the laminating of a luminous layer, a hole-injection layer, the electron-injection layer, etc. and forming them as an organic-semiconductor film. Or if it adjusts also in spin coat processing and DIP processing by making surface tension of liquid material into 30 or less dyn/cm when material with a hole-injection layer and an electron-injection layer common to R, G, and B can be used, it is possible to carry out pattern formation only to a pixel field. Although the polystyrene sulfonic acid was added into the hole-injection material (for example, the poly

thiophene derivatives, such as polyethylene dioxythiophene) used for an organic EL element as an example, the water dispersion was diluted with the low alcoholic system of the surface tension of the low of surface tension, a Cellosolve system solvent, or a methanol, or other aqueous system solvents, and it prepared so that surface tension might become 30 or less dyne/cm.

[0112] This solution for spin coats showed the contact angle of 20 degrees or more on 60 degrees or more and the ITO front face to the bank which carried out surface treatment (plasma treatment).

[0113] If the organic-semiconductor film 43 is formed, Counterelectrode op will be formed all over the simultaneously of the transparent substrate 10, and active-matrix type display will be completed.

[0114] According to the above manufacture methods, since each organic-semiconductor film 43 corresponding to R, G, and B can be formed in a predetermined field using the ink-jet method, full color active-matrix type display can be manufactured for high productivity. And since an organic-semiconductor film can be formed by uniform thickness for every pixel, unevenness does not arise in a luminosity. Moreover, since the thickness of an organic-semiconductor film is uniform, the drive current of the thin film light emitting device 40 does not concentrate in part, and the fall of the reliability of the thin film light emitting device 40 can be prevented.

[0115] In addition, although TFT is formed also in the data side drive circuit 3 or the scan side drive circuit 4, such TFT uses all or a part of processes which forms TFT for a pixel 7, and is performed. So, TFT which constitutes a drive circuit will also be formed between the same layers as TFT of a pixel 7. Moreover, about 1st TFT20 and 2nd TFT30, although another side is [P type and one side / any of P type] satisfactory for N type and both sides at N type, even if both sides are which such combination, they can form TFT by the well-known method.

[0116] (Other modifications) In addition, without being limited to the above-mentioned embodiment, this invention can be variously changed within the limits of this invention, and can be carried out.

[0117] For example, this invention is applicable to a light filter. Drawing 6 is the cross section of an example of the light filter applied to this invention. in this case, the batch which formed as a bank the transparent substrate 300 which turns into a substrate from glass or a quartz with black material, such as a resin, -- the coloring resin 302 is used for a member 301 as a liquid material a batch -- as a member 301, you may form a black matrix with the application of black pigment and a color, a chrome oxide, a chromium metal membrane, etc. the transparent substrate 300 top -- a batch -- the ink-jet method after forming a member 301 -- a batch -- the crevice coated field 303 surrounded by the member 301 is filled up with the coloring resin 302 In addition, if it is the thing which filled up with arbitrary fluids the crevice surrounded by the member of an invoice, and was obtained, and its manufacture method, application of this invention is possible.

[0118] The width of face a of a bank and the width of face b of a coated field were changed as shown in the 1st table as an example, display as set height c of a bank to 2 micrometers and shown in drawing 6 was produced, and the diameter d of a drop applied to the coated field using the application liquid of 30 micrometerphi by the ink-jet method. The following error criteria estimate a result and it is shown in the 1st table. However, the other conditions were as follows.

Bank material: Polyimide (the laminated-structure bank of a SiO2+ polyimide is sufficient.)
Substrate material : ITO bank surface contact angle: 60 degrees (plasma treatment)
Coated field contact angle: 10 degrees (plasma treatment)
Liquid material: Poly para-phenylene vinylene precursor solution (what melted the PPV precursor in the solution which makes DMF a principal component, carried out little addition of a glycerol and the diethylene glycol, and was ink-ized)
Error-criterion O: Simultaneous **** of R, G, and B which are completely settled in a crevice (

drawing 7 D) is possible for a drop, without a residue remaining on a bank.
[0119]
O : Although a drop is settled in a crevice, a residue remains in a bank a little (drawing 7 C).
**: A drop will run aground on a bank. (Drawing 7 B)
Material remains on an after [dryness] bank. The simultaneous regurgitation of R, G, and B is impossible.
[0120] x: It overflows to the crevice where liquid material adjoins (drawing 7 A).
Though the wetting to which wetting does not spread completely in a crevice (drawing 7 E) spreads, since thickness is thin, several times of overprints are needed.
[0121]
[Table 1]

		a (μm)			
		5	10	20	30
b μm	10	×	×	△	△
	15	×	○	○	○
	20	○	○	○	○
	30	◎	◎	◎	◎
	50	◎	◎	◎	◎
	160	×	×	×	×

As mentioned above, as stated to the 1st - the 3rd example, and its modification in detail, in the ink-jet method, by fitness-izing the size of the bank to the diameter of a drop of liquid material, and a coated field, there is no color mixture between pixels and the very few display of dispersion in the thickness for every pixel is obtained. Moreover, simultaneous patterning of R, G, and B also becomes possible.
[0122] Moreover, in the spin coat method or a dipping method, still more detailed patterning becomes possible by specifying the surface tension of liquid material.
[0123] In addition, even if it is except display or display, this invention is effective in the substrate which has the wiring used for these also in formation of an electron device, for example, a TFT element, and is applied effective in an organic EL element, display, or a light filter.
[0124] Then, the 4th which carried out invention of a claim according to claim 30 to 48 - the 7th example, and its modification are explained.
[0125] (4): The 4th example of the 4th example this invention is related with the thin film formation method at the time of forming a bank with single material. The manufacturing process cross section of this example is shown in drawing 8 A - 8D. this example is applied to all uses that fill up with a predetermined fluid the field which established the bank in the bank forming face in arbitrary configurations, and was divided on the bank. For example, when filling up a coloring resin into a pixel field with the case where an organic semiconductor material is filled

up with the display device using the organic-semiconductor thin film into a pixel field, or a light filter, it can apply.

[0126] Bank formation process (drawing 8 A) : A bank formation process is a process which forms a bank in a bank forming face. Even if a bank forming face is the drive substrate in which the TFT (TFT:Thin Film Transistor) used for display was formed, it may be a transparent substrate used for a light filter. a batch -- a member -- if it is the purpose which fills up with a fluid the field surrounded on a bank, and forms a thin film in it, there will be no limitation in the structure of a bank forming face However, it is desirable that the front face is formed by the member with high adhesion with a bank. It is desirable in order that consisting of especially inorganic material may acquire suitable compatibility with next surface treatment. It consists of glass, a quartz, etc., if ITO which is a transparent electrode if it is display is a light filter.

[0127] A bank may be a member which functions as a batch member, for example, it may be desirable to consist of insulating organic materials, such as a polyimide, and the material may have insulation, a property as a semiconductor, and conductive any. It is desirable in order that consisting of especially organic materials may acquire suitable non-compatibility with next surface treatment. A batch member may make a cover function make it serve a double purpose in a light filter. In order to form as a covered member, the material for black matrices uses metals and oxides, such as chromium. Formation of a bank can choose arbitrary methods, such as the lithography method and print processes. When using the lithography method, according to the height of a bank, an organic material is applied by predetermined methods, such as a spin coat, a spray code, a roll coat, a die coat, and a DIP coat, and a resist layer is applied on it. And it leaves the resist doubled with the bank configuration by giving a mask according to a bank configuration, and exposing and developing a resist. It **********s at the end and the bank material of portions other than a mask is removed. When using print processes, an organic material is directly applied to a bank configuration by arbitrary methods, such as intaglio printing, lithography, and letterpress. Even if the height of a bank 110 fills up with thin-film-material liquid the crevice 101 surrounded on a bank, it is formed in the crevice which adjoins with surface tension at the height which is the grade to which thin-film-material liquid does not overflow. For example, the oak and bank 110 which form the thin film layer 204 after heat-treatment by the thickness of 0.05 micrometers - 0.2 micrometers are formed in a height of 1 micrometer - about 2 micrometers.

[0128] Surface treatment process (drawing 8 B) : A surface treatment process is a process which performs plasma treatment under fixed conditions and adjusts the compatibility over the thin-film-material liquid of the bank forming face 100 and a bank 110. In the plasma treatment of this invention, the gas which contains a fluorine as introductory gas is used. Even if it is the reduced pressure plasma treatment under reduced pressure atmosphere, you may be the atmospheric pressure plasma treatment under atmospheric pressure atmosphere. It is desirable that the oxygen of a constant rate is contained in reactant gas. As a fluorine system compound, the halogen gas of CF4, SF6, and CHF3 grade is used.

[0129] It can know whether a front face shows wetting, a cone, and whether it is hard to get wet or compatibility is shown and non-compatibility to arbitrary fluids, such as thin-film-material liquid, by measuring the contact angle to the fluid of a material-list side. When plasma treatment of an organic material and the inorganic material is carried out to drawing 9 , drawing which measured how a contact angle would change with the mixing ratio of a fluorine compound and oxygen is shown. This measurement performed plasma treatment as stated above to the front face of the substrate which formed a polyimide, ITO, or SiO2 in the whole surface, and was performed by measuring the contact angle about the following ink.

[0130] About the substrate in which the polyimide film was formed, PPV precursor ink (what made DMF the principal component for the precursor solution, carried out little addition of a glycerol and the diethylene glycol, diluted with the mixed solvent, and was ink-ized) was used.

[0131] About the substrate in which ITO or SiO2 was formed, a methanol, a glycerol, and ethoxy

ethanol were added to the water dispersion of hole-injection material (what added the polystyrene sulfonic acid to polyethylene dioxythiophene), and what was ink-ized was used for it.

[0132] A contact angle is a contact angle to a fluid with the hydrophilic property of ink etc. CF4 is used as a fluorine system compound here, the polyimide is used as an organic material and SiO2 and ITO (Indium-Tin-Oxide) are used as inorganic material. As shown in drawing 9 , under atmosphere where oxygen is excessive, an organic material and inorganic material do not have a big difference in the grade of a contact angle. However, if a fluorine system compound makes it excessive, the contact angle of an organic material will become large (it becomes non-compatibility). On the other hand, change of the contact angle of inorganic material is small. If oxygen is contained in reactant gas, a polar group will generate inorganic material and an organic material by the oxidation by oxygen. However, in order for a fluorine compound molecule to enter into an organic material that a fluorine system compound is excessive, it is thought that the influence of a polar group decreases relatively. Therefore, while a fluorine system compound controls by excessive conditions compared with oxygen, by carrying out plasma treatment, an organic material and each inorganic material can be set as a desired contact angle (compatibility) according to drawing 9 . especially -- best [of drawing 9] -- it is desirable to use a mixing ratio (CF4/CF4+O2=75%), or to introduce CF4 and helium mixed gas in atmospheric pressure in order to make the difference of both contact angle into the maximum

[0133] Reduced pressure plasma treatment or atmospheric pressure plasma treatment is performed so that a fluorine system compound may be made into introductory gas and oxygen may be mixed at a fixed rate from the above fact. For example, as shown in drawing 8 B, in capacity-coupling type plasma treatment, the above-mentioned gas is passed to a reaction chamber, the substrate which has the bank forming face 100 on an electrode is laid, and electric field are added from a power supply 200 between the electrodes 201 of another side. various a well-known method, for example, a direct current anodizing process, a RF method, an inductive-coupling form, a capacity-coupling form, microwave methods, methods of adding electric field and a magnetic field to **, etc. can be looked like [how to add the energy to a reaction chamber], and it can apply to it Surface treatment made into arbitrary contact angles according to drawing 9 with the mixing ratio of the fluorine system compound and oxygen by plasma treatment is performed.

[0134] Surface treatment is carried out so that the degree of affinity to the thin-film-material liquid of the bank forming face 100 (base of a crevice 101) and a bank 110 may become the turn of a "bank forming face >> bank front face" with the surface treatment concerned.

[0135] Thin film formation process (drawing 8 C, 8D): A thin film formation process is a process which fills up with thin-film-material liquid 203 the crevice 101 surrounded on the bank 110, and forms a thin film layer in it. After restoration of thin-film-material liquid 203 evaporates a solvent component by heat-treatment etc., and forms the thin film layer 204. It is desirable to be based on an ink-jet method as a method filled up with thin-film-material liquid. It is because according to the ink-jet method a fluid can be filled up into arbitrary positions with arbitrary amounts and it can fill up with small equipment which is used for a home printer.

[0136] As shown in drawing 8 C, the regurgitation of the thin-film-material liquid 203 is carried out to the crevice 101 surrounded on the bank 110 from the ink-jet formula recording head 202. Discharge quantity is taken as an amount which becomes desired thickness, when volume decreases by heat-treatment. Viscosity is usually several pc or less making it breathe out from an ink-jet formula recording head. The upper surface and the side of a bank 110 show moderate non-compatibility to thin-film-material liquid 203 with surface treatment. For this reason, it fills up, so that it rises in the position of S1, without surface tension's acting and thin-film-material liquid 203 overcoming a bank 110, even if it breathes out a lot of thin-film-material liquid 203 compared with the thickness of the thin film layer 204, as shown in drawing 8 D at the time of restoration. If filled up with thin-film-material liquid, heat-treatment etc. will be performed and a

solvent component will be evaporated. When a solvent component evaporates, as shown in drawing 8 D, the volume of thin-film-material liquid 203 decreases, and the thin film layer 204 is formed in the bottom of a crevice 101. Since surface treatment of the bottom of the crevice 101 which is the bank forming face 100 at this time is carried out so that compatibility may be shown, the thin film layer 204 sticks it suitably. Moreover, if conditions are chosen so that a contact angle may not become large extremely in drawing 9 about the contact angle of a bank 110, the thin film layer 204 can be formed by almost uniform thickness, without crawling thin-film-material liquid 203 extremely by the side attachment wall of a bank 110. The amount of the thin-film-material liquid 203 breathed out is adjusted so that the thickness of the thin film layer 204 after formation may be set to 0.1 micrometers - about 2 micrometers.

[0137] In addition, as an ink-jet method, you may be the method of carrying out the regurgitation by gassing by heat also in a piezo jet method. The nozzle and the piezo-electric-crystal element are equipped with and constituted from a piezo jet method by the pressure room. If voltage is impressed to the piezo-electric-crystal element with which the fluid is filled up into the pressure room, a volume change will arise in a pressure room and the drop of a fluid will be breathed out from a nozzle. By the method which carries out the regurgitation by gassing, the heating element is prepared in the pressure room which passes to a nozzle. A heating element is made to generate heat, the fluid of the nozzle neighborhood is boiled, a foam is generated, and the regurgitation of the fluid is carried out by the cubical expansion. A piezo jet method is desirable at a point without transformation of the fluid by heating.

[0138] As described above, according to this example, a bank front face can carry out surface treatment of the bank forming face to non-compatibility at a stretch to thin-film-material liquid at compatibility by performing plasma treatment on the conditions which oxygen is mixing in a fluorine system compound. And the contact angle which shows the degree of compatibility according to a property as shown in drawing 9 can be set up easily. That is, the bank itself can control the compatibility of a bank and a bank forming face certainly, without passing through many processes like before for compatibility control, maintaining high adhesion with a bank forming face. It can prevent by this that thin-film-material liquid flows out across a bank, the yield can be raised, and a manufacturing cost can be decreased.

[0139] (5): The 5th example of the 5th example this invention is related with the thin film formation method at the time of forming a bank by the two-layer structure. The feature is that especially forms a lower layer by inorganic material, and it forms the upper layer by the organic material.

[0140] The manufacturing process cross section of this example is shown in drawing 10 A-10F. this example is applied to all uses that fill up with a predetermined fluid the field which established the bank in the bank forming face in arbitrary configurations, and was divided like the 4th example of the above on the bank. For example, when filling up a coloring resin into a pixel field with the case where an organic semiconductor material is filled up with the display device using the organic-semiconductor thin film into a pixel field, or a light filter, it can apply.

[0141] Lower layer film formation process (drawing 10 A) : A lower layer film formation process is a process which forms the lower layer film 120 in the bank forming face 100. About a bank forming face, it is the same as that of the 4th example of the above. It is desirable in order that consisting of inorganic material as a material of a lower layer film may acquire suitable non-compatibility with next surface treatment. Moreover, it is desirable that it is material with the sufficient bank forming face 100 and sufficient adhesion. For example, when the bank forming face is formed of ITO etc., it is possible to use the general silicon oxide (SiO2) and general silicon nitride as an insulator layer, and an amorphous silicon for the lower layer film 120. When such a material is used, the compatibility between the compatibility of the base of a crevice 101 and the compatibility of the bank upper layer 121 is acquired by plasma treatment. This compatibility is effective in order to fix thin-film-material liquid to crevice 101 base evenly.

Formation of a lower layer film is performed by applying the above-mentioned inorganic material according to desired height by predetermined methods, such as for example, a spin coat, a spray code, a roll coat, a die coat, and a DIP coat. The height of the lower layer film 120 has a desirable grade almost equal to the height of the thin film layer 204. Since the lower layer film 120 has thin-film-material liquid 203 and a certain amount of compatibility, the wall surface and the thin-film-material liquid 203 of the lower layer film 120 stick it in process in which thin-film-material liquid 203 is heat-treated. It is because the distortion of the front face of the thin film layer 204 produced when thin-film-material liquid 203 sticks to the wall surface of the lower layer film 120 can be abolished if the thickness of final thin-film-material liquid 203 and the height of the lower layer film 120 are made almost equal.

[0142] The upper formation process (drawing 10 B) : The upper formation process is a process which forms the bank upper layer 121 on the lower layer film 120. The organic material mentioned in the 4th example of the above as a material of the bank upper layer 121 is used. Using also [member / covered] is also possible. The bank upper layer 121 is alternatively formed in a field to form a bank in. Arbitrary methods, such as print processes and the lithography method, can be chosen. When using print processes, an organic material is directly applied to a bank configuration by arbitrary methods, such as intaglio printing, lithography, and letterpress. When using the lithography method, according to the height of the bank upper layer 121, an organic material is applied by predetermined methods, such as a spin coat, a spray code, a roll coat, a die coat, and a DIP coat, and a resist layer is applied on it. And it leaves the resist doubled with the bank configuration by giving a mask according to a bank configuration, and exposing and developing a resist. It **********s at the end and the material of the bank upper layer of portions other than a mask is removed. Even if the height of a bank 110 fills up with thin-film-material liquid the crevice 101 surrounded on a bank, it is formed in the crevice which adjoins with surface tension at the height which is the grade to which thin-film-material liquid does not overflow. For example, the oak which forms the thin film layer 204 after heat-treatment by the thickness of 0.05 micrometers - 0.2 micrometers, and the doubled height of the lower layer film 120 and the bank upper layer 121 are formed in 1 micrometer - about 2 micrometers.

[0143] Removal process (drawing 10 C) : A removal process is a process which **********s the lower layer film 120 by using the bank upper layer 121 as a mask. The bank upper layer 121 is an organic material, and can act as a resist. Therefore, only the lower layer film 120 can be alternatively **********ed by choosing etching material. For example, the bank upper layer 121 is formed beforehand more thickly than the thickness of a schedule, dry etching of the whole is carried out together with a lower layer film, or when the lower layer film 120 is formed by SiO2, wet etching of the fluoric acid is used and carried out to an etching reagent. Lower layer films 120 other than the bank formation field as for which the mask is carried out by this processing in the bank upper layer 121 are removed.

[0144] Surface treatment process (drawing 10 D) : A surface treatment process is a process which performs plasma treatment under fixed conditions and adjusts the compatibility over the bank forming face 100, the lower layer film 120, and the thin-film-material liquid of the bank upper layer 121. Plasma treatment of this invention is also performed by the same conditions and same gas as the above-mentioned operation gestalt 1. If the bank forming face 100 and the lower layer film 120 are especially chosen as ITO and SiO2, respectively, this surface treatment can perform a suitable compatibility setup. That is, since both ITO and SiO2 are inorganic material as shown in drawing 9 , although the change property by the mixing ratio of a fluorine system compound and oxygen is similar, the direction of SiO2 is in the inclination for the grade of compatibility to be high. For this reason, with the above-mentioned surface treatment, surface treatment of the grade of the compatibility of the bank forming face 100, the lower layer film (bank lower layer) 120, and the bank upper layer 121 can be carried out so that it may become the turn of the "bank forming face >= bank lower layer surface > bank upper front

face."
[0145] Thin film formation process (drawing 10 E, 10F) : A thin film formation process is a process which fills up with thin-film-material liquid 203 the crevice 101 surrounded in the bank lower layer 120 and the upper layer 121, and forms a thin film layer in it. The detail is the same as the 4th example of the above. After restoration of thin-film-material liquid 203 evaporates a solvent component by heat-treatment etc., and forms the thin film layer 204.
[0146] ** which breathes out thin-film-material liquid 203 from the ink-jet formula recording head 202 to the crevice 101 surrounded on the bank as shown in drawing 10 E. Discharge quantity is taken as an amount which becomes desired thickness, when volume decreases by heat-treatment. As for this thickness, it is desirable that it is almost equal to the thickness of the bank lower layer 120 by the reason for the above. It fills up, so that it rises in the position of S3, without the surface tension of the bank upper layer 121 acting, and thin-film-material liquid 203 overcoming a bank, even if it breathes out a lot of thin-film-material liquid 203 compared with the thickness of the thin film layer 204, as shown in drawing 10 E at the time of restoration. If filled up with thin-film-material liquid, heat-treatment etc. will be performed and a solvent component will be evaporated. When a solvent component evaporates, as shown in drawing 10 F, the volume of thin-film-material liquid 203 decreases, and the thin film layer 204 of thickness of the same grade as the bank lower layer 120 is formed by the thickness in the front face S4 of the bottom of a crevice 101. Since surface treatment of the bottom of the crevice 101 which is the bank forming face 100 at this time is carried out so that compatibility may be shown, the thin film layer 204 gets wet suitably. Moreover, the contact angle of the bank lower layer 120 is smaller than the bank upper layer 121, and is stuck with thin-film-material liquid 203 by moderate compatibility. For this reason, thin-film-material liquid 203 is not crawled by the side attachment wall of the bank lower layer 120. Moreover, since the bank lower layer 120 and the thin film layer 204 are the almost same thickness, thin-film-material liquid 203 is not dragged by the side attachment wall of the bank lower layer 120. For this reason, the thin film layer 204 can be formed by almost uniform thickness. The amount of the thin-film-material liquid 203 breathed out is adjusted so that the thickness of the thin film layer 204 after formation may be set to 0.1 micrometers - about 2 micrometers.
[0147] As described above, according to this example, it can set up so that compatibility may go up to the bank which carried out the laminating of inorganic material and the organic material in order of the bank upper layer, a bank lower layer, and a bank forming face by performing plasma treatment on the conditions which oxygen is mixing in a fluorine system compound. That is, the bank itself can terminate surface treatment at a stretch by control of easy plasma treatment, without passing through many processes like before for compatibility control, maintaining high adhesion with a bank forming face. It can prevent by this that thin-film-material liquid flows out across a bank, the yield can be raised, and a manufacturing cost can be decreased. The effect that a uniform thin film layer can be formed especially is done so.
[0148] (6): The 6th example of the 6th example this invention forms a bank by the two-layer structure by different method from the 5th example of the above.
[0149] The manufacturing process cross section of this example is shown in drawing 11 A-11F, and drawing 12 A - 12 C. This operation form is applied to all uses that fill up with a predetermined fluid the field which established the bank in the bank forming face in arbitrary configurations, and was divided like the 4th example of the above on the bank. For example, when filling up a coloring resin into a pixel field with the case where an organic semiconductor material is filled up with the display device using the organic-semiconductor thin film into a pixel field, or a light filter, it can apply. Since it is the same as that of the above 4th and the 5th example about the material about a bank forming face, a lower layer film, and the bank upper layer, or thickness, explanation is omitted.
[0150] Lower layer film formation process (drawing 11 A) : A lower layer film formation process is a process which forms the lower layer film 130 in the bank forming face 100. The lower layer

film 130 is formed by the same method as the 5th example of the above.
[0151] Exposure process (drawing 11 B) : An exposure process is a process which carries out exposure development of the lower layer film 130 according to a bank configuration. According to a bank configuration, a mask 132 is formed in the upper part of the lower layer film 130. The mask of the case of the material which the lower layer film 130 hardens by energy grant is carried out so that a bank formation field may be made to penetrate light and a removal field may not be made to penetrate light. In the case of the material into which the lower layer film 130 deteriorates possible [removal] by energy grant, the light of a bank formation field is intercepted, and it carries out a mask so that a removal field may be made to penetrate light. In this example, it is possible to change independently a bank configuration [in / eye the hatchet which can be etched, and a lower layer / for not the thing that **********s a lower layer by using the bank upper layer as a mask but a lower layer and the upper layer], and the bank configuration in the upper layer. By choosing the configuration of this bank lower layer as a suitable thing, a thin film layer can be suitably prepared now. In addition, energy sources, such as a laser beam, perform exposure using a well-known method.
[0152] Etching process (drawing 11 C) : An etching process is a process which leaves the field exposed and hardened and removes the lower layer film 130. A mask and the lower layer film 130 of a removal field are removed after exposure using a solvent. Etching uses fluoric acid as an etching reagent, when SiO2 and polysilazane are used as a lower layer film 130. Moreover, you may use dry etching.
[0153] The upper film formation process (drawing 11 D) : The upper film formation process is a process which covers the bank lower layer 130 and forms the upper film 130. The upper film 131 is formed by the same method as the above-mentioned lower layer film 130.
[0154] Exposure process (drawing 11 E) : An exposure process is a process which exposes the upper film 131 according to the upper bank configuration. According to the configuration of the bank upper layer, a mask 134 is formed on the upper film 131. The mask of the case of the material which the upper film 131 hardens by energy grant is carried out so that a bank formation field may be made to penetrate light and a removal field may not be made to penetrate light. In the case of the material into which the upper film 131 deteriorates possible [removal] by energy grant, the light of a bank formation field is intercepted, and it carries out a mask so that a removal field may be made to penetrate light. As mentioned above, with this operation gestalt, you may change the configuration of the bank upper layer 131 with a lower layer. In addition, energy sources, such as a laser beam, perform exposure using a well-known method.
[0155] Etching process (drawing 11 F) : An etching process is a process which leaves the field exposed and hardened and removes the upper film 131. A mask and the upper film 131 of a removal field are removed after exposure using a solvent. Etching uses fluoric acid as an etching reagent, when a polyimide is used as an upper film 131. Moreover, you may use dry etching.
[0156] Surface treatment process (drawing 12 A) : Since it is the same as that of the 5th example of the above about a surface treatment process, explanation is omitted. With this surface treatment, surface treatment of the grade of the compatibility of the bank forming face 100, the bank lower layer 130, and the bank upper layer 131 can be carried out so that it may become the turn of the "bank forming face >= bank lower layer surface > bank upper front face."
[0157] Thin film formation process (drawing 12 B, 12C) : A thin film formation process is a process which fills up with thin-film-material liquid 203 the crevice 101 surrounded in the bank lower layer 130 and the upper layer 131, and forms a thin film layer in it. Since it is the same as that of the 5th example of the above about a thin film formation process, explanation is omitted.

[0158] As described above, according to this example, it can set up so that compatibility may go up to the bank which carried out the laminating of inorganic material and the organic material in

order of the bank upper layer, a bank lower layer, and a bank forming face by performing plasma treatment on the conditions which oxygen is mixing in a fluorine system compound. That is, the bank itself can terminate surface treatment at a stretch by control of easy plasma treatment, without passing through many processes like before for compatibility control, maintaining high adhesion with a bank forming face. It can prevent by this that thin-film-material liquid flows out across a bank, the yield can be raised, and a manufacturing cost can be decreased. The effect that it can form in a configuration which can form a uniform thin film layer and is especially different in a bank lower layer and the upper layer is done so.

[0159] (7): The 7th example [7th] of an example is related with the display manufactured with the application of the 5th example mentioned above in actual display.

[0160] (Whole composition) It is the same as that of this display having changed with active-matrix type display, and drawing 3 mentioned above having explained the whole composition (for this reason, the sign of a component omits explanation of the duplication portion using the same thing as drawing 3). drawing 13 -- it -- constituting -- having -- **** -- a pixel -- one -- a ** -- extracting -- being shown -- a plan -- drawing 14 -- A - 14 -- C -- respectively -- drawing 13 -- a cutting plane -- A-A -- ' -- it can set -- a cross section -- a cutting plane -- B-B -- ' -- it can set -- a cross section -- and -- a cutting plane -- C-C -- ' -- it can set -- a cross section -- it is .

[0161] This active-matrix type display 1 is different in respect of the following, although the whole composition is the same as the thing of drawing 3 mentioned above, and equivalent.

[0162] That is, each pixel 7 is formed in the crevice surrounded in the bank layer bank. This bank layer carries out the laminating of the lower layer side insulator layer 61 and the upper layer side insulator layer 62, and is constituted. The operation gestalt 3 is applied to manufacture of this bank layer bank. About conditions, such as the material, height, etc., it is the same as that of the operation gestalt 3. An organic semiconductor material is used as thin-film-material liquid. The organic-semiconductor film 43 is formed by breathing out and heating this material to the field surrounded in the bank layer bank. For example, it is formed so that the organic-semiconductor film 43 may be set to 0.2 micrometers - about 1.0 micrometers and 1 micrometer - about 2 micrometers, respectively in the oak which is 0.05 micrometers - 0.2 micrometers, the lower layer side insulator layer 61, and the upper layer side insulator layer 62.

[0163] Moreover, 1st TFT20 and 2nd TFT30 are formed with the island-like semiconductor film, as shown in drawing 7 and drawing 8 . As an organic-semiconductor film 43, the material which emits light by impression of electric field, for example, a polyphenylene vinylene, (PPV) is used.

[0164] (Operation of a bank layer) In the above-mentioned composition, before the bank layer bank is filled up with the organic semiconductor material 203 with an ink-jet method, plasma treatment which made the fluorine or the fluorine compound introductory gas like the above-mentioned operation gestalt is carried out. For this reason, the compatibility over an organic semiconductor material is formed in the turn of insulating-layer 62 a pixel electrode 41>= lower layer side insulating-layer 62> upper layer side. For this reason, even if filled up with the thin-film-material liquid containing the organic semiconductor material to the limit of the pixel field surrounded in the bank layer bank, the organic-semiconductor film 43 can settle in the height of the lower layer side insulating layer 62, it can prevent that the organic-semiconductor film 43 solidifies in the shape of a concave letter, and the flat organic-semiconductor film 43 can be formed. Although the drive current of the thin film light emitting device 40 will concentrate there and the reliability of the thin film light emitting device 40 will fall when the thin portion of thickness is in the organic-semiconductor film 43, a title can be eliminated while it is such.

[0165] Moreover, in this example, the bank layer bank is formed also in the field which laps with the relay electrode 35 of the flow control circuit 50 among the formation fields of the pixel electrode 41, and the organic-semiconductor film 43 is not formed in the field which laps with

the relay electrode 35. That is, the organic-semiconductor film 43 is formed only in a flat portion among the formation fields of the pixel electrode 41. It is the factor to which this also maintains the organic-semiconductor film 43 to fixed thickness.

[0166] Furthermore, if there is no bank layer bank in the field which laps with the relay electrode 35, also in this portion, between Counterelectrodes op, drive current will flow and the organic-semiconductor film 43 will emit light. However, this light is inserted between the relay electrode 35 and Counterelectrode op, and outgoing radiation is not carried out outside, and it does not contribute to a display. The drive current which flows in the portion which does not **** to this display can be called reactive current seen from the field of a display. However, with this gestalt, if it was the former, the bank layer bank was formed in the portion into which such the reactive current should flow. For this reason, it can prevent that useless current flows to the common feeder com, and the width of face of the common feeder com may come to be narrow that much. As the result, luminescence area can be increased and display performances, such as brightness and a contrast ratio, can be raised.

[0167] Moreover, patterning becomes possible, without having good control of striking a ball in any direction for every primary color, and using complicated processes, such as the photolithography method, by using an ink-jet method, since an organic-semiconductor film can be formed.

[0168] In addition, you may form the bank layer bank by the black resist. The bank layer bank functions as a black matrix, and its display grace, such as a contrast ratio, improves. That is, in the active-matrix type display 1 concerning this gestalt, since Counterelectrode op is formed in the front-face side of the transparent substrate 10 all over a pixel 7, the reflected light in Counterelectrode op reduces a contrast ratio. However, if the blowout layer bank which bears the function which lessens a parasitic capacitance is constituted from a black resist, since the bank layer bank can be operated as a black matrix and the reflected light from Counterelectrode op will be interrupted, a contrast ratio can be raised.

[0169] The bank layer bank is constituted along with the data line sig and the scanning line gate more thickly than the organic-semiconductor film 41, and Counterelectrode op is formed in this. Therefore, when the bank layer bank exists, it is prevented that a big capacity is parasitic on the data line sig. namely, the data line sig and Counterelectrode op -- since the thick bank layer bank intervenes in between [every], **** which is parasitic on the data line sig is very small So, the load of the drive circuits 3 and 4 can be reduced and low-power-izing and/or improvement in the speed of a display action can be attained.

[0170] Moreover, the bank layer bank consists of the two-layer structure which consists of inorganic material and an organic material. If it is going to form a bank layer with thick thickness only by inorganic material, it is necessary to form the film which consists of inorganic material over long time by the PECVD method etc. On the other hand, organic materials, such as a resist and a polyimide film, are easy to form a comparatively thick film. Since the bank layer bank of this operation gestalt constitutes the upper layer side insulator layer 62 from an organic material with easy thick-film-izing, and the bank stratification can be managed in a short time, productivity can be raised.

[0171] Moreover, if it is this two-layer structure, although the organic-semiconductor film 41 has touched in the lower layer side insulator layer 61 which consists of inorganic material, it does not touch in the upper layer side insulator layer 62 which consists of an organic material. So, since the organic-semiconductor film 41 does not deteriorate in response to the influence of the upper layer side insulator layer 62 which consists of organic materials, in the thin film light emitting device 40, neith r the decline in luminous efficiency nor the fall of reliability occurs.

[0172] Moreover, according to this example, since the bank layer bank is formed also in the boundary region (outside field of a display 11) of the transparent substrate 10, the data side drive circuit 3 and the scan side drive circuit 4 are also covered by the bank layer bank. If

Counterelectrode op is formed in the display 11 at least, it is enough and it is not necessary to form it even in a drive circuit field. However, since doubling precision is bad when Counterelectrode op is formed by the mask spatter method, Counterelectrode op may be formed even in a drive circuit field. In this example, though Counterelectrode op is formed even in these drive circuit fields, the bank layer bank will intervene between the wiring layer of a drive circuit, and Counterelectrode op. For this reason, since it can prevent that capacity is parasitic on the drive circuits 3 and 4, the load of the drive circuits 3 and 4 can be reduced and low-power-izing and/or improvement in the speed of a display action can be attained.

[0173] (Operation of display) In the active-matrix type display 1 constituted as mentioned above, if it is chosen by the scanning signal and 1st TFT20 is turned on, the picture signal from the data line sig will be impressed to the gate electrode 31 of 2nd TFT30 through 1st TFT20. A picture signal is simultaneously written in retention volume cap through 1st TFT20. Consequently, if 2nd TFT30 is turned on, voltage will be impressed by making Counterelectrode op and the pixel electrode 41 into a negative electrode and a positive electrode, respectively, and the current (drive current) which flows on the organic-semiconductor film 43 in the field in which applied voltage exceeded threshold voltage will increase rapidly. Therefore, a light emitting device 40 emits light as electroluminescent element or a Light Emitting Diode element. It is reflected by Counterelectrode op, and the light of a light emitting device 40 penetrates the transparent pixel electrode 41 and the transparent transparent substrate 10, and is injected. If 2nd TFT30 is turned off, the drive current for performing such luminescence will not flow, in order to flow Counterelectrode op, the organic-semiconductor film 43, the pixel electrode 41, 2nd TFT30, and the current path that consists of common feeders com. However, since the gate electrode of 2nd TFT30 is held at the potential which is equivalent to a picture signal with retention volume cap even if 1st TFT20 is turned off, 2nd TFT30 is still an ON state. So, drive current continues flowing to a light emitting device 40, and this pixel is still a lighting state. New image data is written in maintenance **** cap, and this state is maintained until 2nd TFT30 is turned off.

[0174] (The manufacture method of display) It explains, referring to drawing 15 A-15C or drawing 20 A - 20C about the manufacture method of the active-matrix type display of the above-mentioned composition to a degree. This manufacture method applies the manufacture method of the 5th example to display.

[0175] Semiconductor stratification process (drawing 15 A-15C) : The transparent substrate 10 is received first. The ground protective coat to which it is thin by the plasma CVD method from the silicon oxide which is about 2000-5000A if needed by making TEOS (tetrapod ethoxy silane), oxygen gas, etc. into material gas (it does not illustrate.) After forming, the semiconductor film on which it is thin by the plasma CVD method from the amorphous silicon film which is about 300-700A is formed in the front face of a ground protective coat. Next, to the semiconductor film which consists of an amorphous silicon film, crystallization processes, such as laser annealing or a solid phase grown method, are performed, and a semiconductor film is crystallized on a polysilicon contest film. Next, the gate insulator layer 37 to which a semiconductor film putter 2, and it considers as an island-like semiconductor film, and is thin by the plasma CVD method to the front face from the silicon oxide or nitride which is about 600 - 1500A by making TEOS (tetrapod ethoxy silane), oxygen gas, etc. into material gas is formed. Next, after forming the electric conduction film which consists of metal membranes, such as aluminum, a tantalum, molybdenum, titanium, and a tungsten, by the spatter, putter 2, and the installation portions 36 of the gate electrodes 21 and 3l. and the gate electrode 31 are formed. The scanning line gate is formed at this process.

[0176] In this state, high-concentration phosphorus ion is driven in and a source drain field is formed in a self-adjustment target to the gate electrodes 21 and 31. In addition, the portion into which an impurity was not introduced serves as a channel field. Next, after forming an insulator layer 51 between the 1st layer, each contact hole is formed and the installation portions 39 of

data-line sig, the drain electrode 22, the common feeder com, and the common feeder com and the relay electrode 35 are formed. Consequently, 1st TFT20, 2nd TFT30, and retention volume cap are formed.

[0177] Next, an insulator layer 52 is formed between the 2nd layer, and contact hole formation is carried out at the portion which is equivalent to this layer insulation film at the relay electrode 35. Next, after forming an ITO film in the whole front face of an insulator layer 52 between the 2nd layer, putter 2, and through a contact hole, it connects with the source drain field of 2nd TFT30 electrically, and the pixel electrode 41 is formed in it every pixel 7.

[0178] Lower layer side insulator layer formation process (drawing 16 A-16C) : Next, the film (inorganic film for forming the lower layer side insulator layer 61) which is from inorganic material on the front-face side of an insulator layer 52 by the PECVD method etc. between the 2nd layer is formed. This film is formed by the inorganic material and thickness which were explained with the above-mentioned operation gestalt. Membranous thickness is formed more thickly than the organic-semiconductor film 41. For example, the film of the oak which forms the organic-semiconductor film 41 in the thickness of 0.05 micrometers - 0.2 micrometers, and inorganic material is formed in the thickness of 0.2 micrometers - about 1.0 micrometers.

[0179] Upper layer side insulator layer formation process (drawing 17 A-17C) : Subsequently along with the scanning line gate and the data line sig, a resist (upper layer side insulator layer 62) is formed. The upper layer side insulator layer 62 consists of organic materials of the above-mentioned operation gestalt. The thickness of the upper layer side insulator layer 62 is formed in the pixel field which adjoins even if it fills up a pixel field with thin-film-material **** at the height which may become the breakwater which is the grade to which thin-film-material liquid does not overflow. For example, the oak which forms the organic-semiconductor film 41 by the thickness of 0.05 micrometers - 0.2 micrometers, and the upper layer side insulator layer 62 are formed in a height of 1 micrometer - about 2 micrometers.

[0180] Removal process (drawing 18 A-18C) : Next, putter 2 NGU is given to the film which consists of inorganic material by using the upper layer side insulator layer 62 as a mask. Consequently, the film which consists of inorganic material remains along with the scanning line gate and the data line sig, and the lower layer side insulator layer 61 is formed. Thus, the bank layer bank of the two-layer structure which consists of a lower layer side insulator layer 61 and an upper layer side insulator layer 62 is formed. At this time, the resist portion which it leaves along with the data line sig presupposes that it is broad so that the common feeder com may be covered. Consequently, the field which should form the organic-semiconductor film 43 of a light emitting device 40 is surrounded by the bank layer bank.

[0181] Surface treatment process (drawing 19 A-19C) : Next, plasma treatment is performed using a fluorine to set [the front face of the pixel electrode 41] the lower layer side insulator layer 61 as compatibility in the meantime for the upper layer side insulator layer 62 to thin-film-material liquid at non-compatibility at compatibility (for it to be a hydrophilic property when thin-film-material liquid contains moisture) to thin-film-material liquid. The concrete method is the same as that of the 4th and 5th examples.

[0182] Surface treatment is carried out so that the degree of affinity to the thin-film-material liquid of the pixel electrode 41, the lower layer side insulator layer 61 (inorganic material), and the upper layer side insulator layer 62 (organic material) may become the turn of "being an insulator layer front face a pixel electrode surface >= lower layer side insulator layer surface > upper layer side" by the above.

[0183] Organic-semiconductor film formation process (drawing 20 A-20C) : If the above-mentioned surface treatment finishes, each organic-semiconductor film 43 corresponding to R, G, and B is formed using the ink-jet method in the field divided in the shape of a matrix in the bank layer bank. The regurgitation of the thin-film-material liquid 203 which is a liquefied material (a precursor / regurgitation liquid) for constituting the organic-semiconductor film 43 from an ink-jet formula recording head 202 to the inside field of the bank layer bank is carried

out to it. Subsequently, 100 degrees C - 150 degrees C heat treatment is performed, and you evaporate the solvent component in thin-film-material liquid, you make it established in the inside field of the bank layer bank, and the organic-semiconductor film 43 is formed. Since the above-mentioned surface treatment is carried out, the bank layer bank shows water repellence here. On the other hand, since the thin-film-material liquid which is the precursor of the organic-semiconductor film 43 uses the solvent of a hydrophilic property, the application field of the organic-semiconductor film 43 does not overflow into the pixel 7 which is specified certainly and adjoins by the bank layer bank. And the contact surface of thin-film-material liquid and a side attachment wall moves to the field of the pixel electrode 41 which shows a hydrophilic property more, and inorganic material, without thin-film-material liquid adhering to a side attachment wall, even if the solvent component of thin-film-material liquid evaporates with heat treatment and ** of thin-film-material liquid decreases, since the side attachment wall of the bank layer bank also has water repellence. Therefore, the organic-semiconductor film 43 formed after heat treatment does not have the circumference with a bird clapper thickly, and holds uniform thickness on a pixel electrode. In addition, what is necessary is just to repeat the restoration and dryness of thin-film-material liquid by the ink-jet method for each class, in forming a multilayer-structure element. For example, it is the case where carry out the laminating of a luminescence film, a hole-injection layer, the electron-injection layer, etc., and they are formed as an organic half conductor layer.

[0184] In addition, in the above-mentioned process, you may form an electron hole transporting bed by the ink-jet method. For example, the thin-film-material liquid which becomes the origin of an electron hole transporting bed can be filled up with the thickness of 3-4 micrometers into the pixel field surrounded in the bank layer. If it heat-treats in this thin-film-material liquid, an electron hole transporting bed with a thickness of 0.05 micrometers - about 0.1 micrometers can be formed. The same thickness will be filled up with the organic semiconductor material described above with the ink-jet method further again if an electron hole transporting bed is formed.

[0185] If the organic half conductor layer 43 is formed, Counterelectrode op will be formed all over the abbreviation for the transparent substrate 10, and the active-matrix type display 1 will be completed (refer to drawing 14 A - 14C).

[0186] According to the above manufacture methods, since each organic-semiconductor film 43 corresponding to R, G, and B can be formed in the predetermined field using the ink-jet method, the full color active-matrix type display I can be manufactured for high productivity. And since an organic half conductor layer can be formed by uniform thickness, nonuniformity does not arise in a luminosity. Moreover, since the thickness of an organic-semiconductor film is uniform and the drive current of the thin film light emitting device 40 does not concentrate in part, it can prevent that the reliability of the thin film light emitting device 40 falls.

[0187] In addition, although TFT is formed also in the data side drive circuit 3 shown in drawing 13 , or the scan side drive circuit 4, it is carried out by using all or a part of processes which forms TFT for the pixel 7 of these TFT **. So, TFT which constitutes a drive circuit will also be formed between the same layers as TFT of a pixel 7. Moreover, about 1st TFT20 and 2nd TFT30, since N type and both sides can form TFT by the well-known method even if P type and one side are which such combination in N type, although any of P type are sufficient as another side, both sides omit the explanation.

[0188] (Other modifications) in addition, it is not limited to the above 4th - the 7th example, and in the range of the meaning of the invention, many things are boiled, it changes and invention according to claim 31 to 49 can be applied

[0189] For example, although the 7th example was an example which applied invention to display, as shown in drawing 21 , you may apply it to a light filter. in this case, the batch which formed as a bank the transparent substrate 300 which consists of glass or a quartz as a bank forming face with black material, such as a resin, -- the coloring resin 302 is used for a member

301 as thin-film-material liquid a batch -- as a member 301, you may form a black matrix with the application of black pigment and a color, a chrome oxide, a chromium metal membrane, etc. the transparent substrate 300 top -- a batch -- since a member 301 is formed -- an ink-jet method -- a batch -- the crevice 303 surrounded by the member 301 is filled up with the coloring resin 302 In addition, this invention is applicable if it is the manufacture method which fills up with arbitrary fluids the crevice surrounded by the member of an invoice.

[0190] Moreover, surface treatment is not restricted to plasma treatment, and if it is the surface treatment method that different compatibility under the same surface treatment conditions is processible as shown in drawing 9 , it is applicable. The main point of this invention is because it is in the point that two or more compatibility can be set up at a stretch by one surface treatment. Therefore, the material which sets up compatibility is not restricted between inorganic material and an organic material, and if it shows the property of the compatibility shown in drawing 9 between specific material, it can apply the surface treatment of this invention between the specific material.

[0191] As mentioned above, according to the 4th - the 7th example, and its modification, since plasma treatment was managed on fixed conditions, the bank itself can control the compatibility of a bank and a bank forming face certainly, without passing through many processes for compatibility control, maintaining high adhesion with a bank forming face. Thereby, the yield can be raised and a manufacturing cost can be decreased.

[0192] Moreover, since the compatibility of a bank and a bank forming face was certainly set up by managing plasma treatment on fixed conditions according to display, the display which can prevent that thin-film-material liquid flows out across a bank, and has the thin film layer of uniform thickness can be offered. Image display which produces unevenness neither in a luminosity nor a color can be performed by this, and reliability can be raised.

[0193] Furthermore, if thin-film-material liquid is filled up with an ink-jet method, since a thin film layer can be had good control of striking in any direction and formed according to the exception of color, the effect that there are few processes which patterning takes compared with the photolithography method etc., and they end is done so. Then, the octavus which carried out invention of a claim according to claim 49 to 74 - the 11th example are explained based on a drawing.

[0194] (8): Explain the surface-treatment method concerning the gestalt 1 of operation of the example this invention of the octavus using a drawing. Drawing 22 shows the contact angle change on the ITO substrate front face of drainage system ink (surface tension 30 mN/m) at the time of continuing oxygen plasma and CF4 plasma treatment and performing them, and a polyimide film front face. This measurement performed plasma treatment as stated above to the front face of a polyimide and the substrate which formed ITO in the whole surface, and was performed by measuring the contact angle about the following ink.

[0195] About the polyimide film and the substrate in which ITO was formed, a methanol, a glycerol, and ethoxy ethanol were added to the water dispersion of hole-injection material (what added the polystyrene sulfonic acid to polyethylene dioxythiophene), and what was ink-ized was used for it.

[0196] Oxygen plasma treatment is 500SCCM, power 1.0W/cm2, and pressure 1torr, and the oxygen gas flow rate performed CF4 plasma treatment for it on the conditions of 900SCCM, power 1.0 W/cm2, and pressure 1torr in CF4 quantity of gas flow.

[0197] In an unsettled stage, although an ITO front face and a polyimide front face show straw-mat water repellence, while it was hydrophilicity-ized by both oxygen plasma treatment and the hydrophilic property on the front face of ITO had been further held by CF4 plasma treatment, it turns out that a polyimide front face is ******(ed). Moreover, when same processing was carried out for glass-substrate **, after CF4 plasma treatment, the contact angle of 20 - 30 degrees was shown.

[0198] Generally the same continuation plasma treatment showed the contact angle of 50

degrees also on the polyimide front face 10 or less degrees on the ITO front face also to organic-solvent system ink, such as a xylene with low surface tension.
[0199] The result which performed ESCA analysis of a polyimide film front face which performed the above-mentioned plasma treatment is shown in Table 2.
[0200]
[Table 2]

	C(%)	N(%)	O(%)	F(%)
未処理	72.7	9.8	17.6	0
O2プラズマ	63.8	9.5	27	0
CF4プラズマ	33.3	3.1	6.8	51.8

Oxygen atoms increase in number by oxygen plasma treatment, fluorine atomic weight is dramatically increased from Table 2 by CF4 plasma treatment, and being fluorine-ized is clear. The joint form showed that -COOH and -COH were once formed of oxygen plasma treatment, and Teflon-ization (-CF2-) had taken place by CF4 plasma treatment.
[0201] Teflon-ization by the above-mentioned plasma treatment is checked even when the negative resist which consists of an acrylic frame is used, and it is very effective in the surface treatment of the organic substance in which pattern formation is possible by photo lithography.
[0202] Furthermore, power 300W, 1mm of distance between electrode-substrates, and oxygen gas plasma were oxygen gas flow rate 80ccm, gaseous helium flow rate 10 l/min, and bearer rate 10 mm/s under atmospheric pressure, and CF4 plasma was able to obtain the same result, when continuation plasma treatment was performed under the conditions of CF4 quantity-of-gas-flow 100ccm, gaseous helium flow rate 10 l/min, and bearer rate 5 mm/s. It is very effective at the point which does not have the time and effort which pulls the processing interior of a room to a vacuum with atmospheric pressure plasma, and can do the same surface treatment simple.
[0203] Moreover, although the case where CF4 gas was used was explained when performing fluorine system gas plasma treatment, the fluorine system gas of not only this but NF3 and SF6 grade can also be used.
[0204] Wettability (surface energy) is controllable by parameters, such as not only the processing time but a quantity of gas flow, power, distance between electrode-substrates, etc.
[0205] Thus, it is possible for an inorganic substance front face to carry out the surface treatment of the organic substance front face to liquid repellance lyophilic by the same oxygen-CF4 continuation plasma treatment.
[0206] (9): Explain the manufacture method of the organic EL element equipped with the organic-semiconductor thin film to the thin film formation method row concerning the 9th example of the 9th example this invention using a drawing.
[0207] Drawing 23 A - 23B is the process cross section showing the manufacture method of an organic EL element.
[0208] At the process shown in drawing 23 A, the bank 302 which consists of a polyimide is formed by the FOTORISO method on the ITO substrate 301. A pattern may be a stripe and the pattern from which it escaped circularly is sufficient as it. The material which forms a bank can use the organic material in which pattern processing not only by a polyimide but the FOTORISO method is possible.
[0209] In the process shown in drawing 23 B, an oxygen gas flow rate performs oxygen plasma treatment for 1 minute on the conditions of 500SCCM(s), power 1.0 W/cm2, and pressure 1torr. You may perform atmospheric pressure plasma treatment by power 300 W, 1mm of distance between electrode-substrates, oxygen gas flow rate 80ccm and the gaseous helium flow rate of 10l. / min, and bearer rate 10 mm/s. The polyimide (hydrophilicity-ized) layer 304 activated by the ITO surface 3 row of a hydrophilic property by oxygen plasma treatment is formed. Oxygen plasma treatment also has the effect of carrying out ashing of the polyimide residue on ITO.
[0210] Then, in the process shown in drawing 23 C, CF4 quantity of gas flow performs CF4

plasma treatment for 30 minutes on the conditions of 900SCCM(s), power 1.0 W/cm2, and pressure 1torr. You may perform atmospheric pressure plasma treatment under the conditions of power 300W, 1mm of distance between electrode-substrates, CF4 quantity-of-gas-flow 100ccm, gaseous helium flow rate 10 l/min, and bearer rate 5 mm/s. A polyimide front face can be reformed on the Teflon-ized liquid repellance front face 305, with the ITO front face 303 of a hydrophilic property held.

[0211] When the grade of contamination on the front face of a substrate was light, the same effect was acquired, even if it did not perform oxygen plasma treatment but CF4 quantity of gas flow performed CF4 plasma treatment for 30 to 60 minutes on the conditions of 900SCCM(s), power 1.0 W/cm2, and pressure 1torr.

[0212] At the process shown in drawing 23 D, the hole-injection layer 306 is formed with a spin coat. Patterning of the hole-injection layer material can be carried out only into an ITO pixel by adjusting the surface tension of hole-injection layer material liquid. Polyethylene dioxythiophene and the water dispersion of a polystyrene sulfonic acid were diluted with ethoxy ethanol and the methanol (a total of 75%), and what was made into the surface tension of 30 dyne/cm was used as a spin coat solution. To hole-injection layer material liquid, in order that a plasma treatment ITO front face may show the contact angle of 10 or less degrees, the paint film of it is carried out to homogeneity. Moreover, on a plasma treatment polyimide front face, in order to show the contact angle of 60 degrees or more, a paint film is not carried out on a bank, and a cross talk is not raised. Moreover, you may carry out patterning membrane formation of the hole-injection layer material ink into an ITO pixel with an ink-jet method. the law of an ink-jet method can boil material markedly, and can save it

[0213] In drawing 23 E, the luminous layer of R, G, B, and three colors is formed by carrying out the regurgitation of red luminous layer material ink 307, green luminous layer material ink 308, and the blue luminous layer material ink 309 to a predetermined pixel, more nearly respectively than the ink-jet head 310. green luminous layer material -- PPV precursive -- the body and its function -- what diluted liquid with the mixed liquor of DMF, a glycerol, and a diethylene glycol, and ink-ized it was used the green ink which used this PPV for red luminous layer material ink -- the red-dyes rhodamine 101 -- PPV -- receiving -- 1.5wt(s)% -- the added ink was used What dissolved the poly JIOKUCHIRUSURU fluorene in the xylene was used for blue luminous layer material ink as ink. Since the contact angle on the plasma treatment polyimide front face of luminescent-material layer ink 307, 308, and 309 is 60 degrees or more, high definition patterning of it which color mixture does not produce becomes possible. When forming a monochrome organic EL element, you may form a luminous layer by the spin coat method.

[0214] Moreover, you may use the substrate in which the bank which consists of two-layer [which made the lower layer a glass layer from which a contact angle with hole-injection layer material liquid or luminous layer ink becomes 20 - 30 degrees by the aforementioned plasma treatment] was formed. A possibility of connecting too hastily at the bank skirt is avoidable.

[0215] (10): Explain the manufacture method of the light filter equipped with the coloring thin film to the thin film formation method row concerning the 10th example of the 10th example this invention using a drawing.

[0216] Drawing 24 A - 24D is the process cross section showing the manufacture method of a light filter.

[0217] At the process shown in drawing 24 A, a resin (black matrix) BM 312 is formed by the FOTORISO method on a glass substrate 311. A pattern may be a stripe and the pattern from which it escaped circularly is suffici nt as it.

[0218] In the process shown in drawing 24 B, an oxygen gas flow rate performs oxygen plasma treatment for 1 minute on the conditions of 500SCCM(s), power 1.0 W/cm2, and pressure 1torr. You may perform atmospheric pressure plasma treatment by power 300 W, 1mm of distance between electrode-substrates, oxygen gas flow rate 80ccm and the gaseous helium flow rate of 10l. / min, and bearer rate 10 mm/s. The resin BM layer 314 activated by the glass surface 13

row of a hydrophilic property by oxygen plasma treatment (hydrophilicity-izing) is formed. Oxygen plasma treatment also has the effect of carrying out ashing of the resin residue on glass.

[0219] Then, in the process shown in drawing 24 C, CF4 quantity of gas flow performs CF4 plasma treatment for 30 minutes on the conditions of 900SCCM(s), power 1.0 W/cm2, and pressure 1torr. You may perform atmospheric pressure plasma treatment under the conditions of power 300W, 1mm of distance between electrode-substrates, CF4 quantity-of-gas-flow 100ccm, gaseous helium flow rate 10 l/min, and bearer rate 5 mm/s. A resin BM front face can be reformed on the Teflon-ized ** ink nature front face 315, with the glass front face 313 of a hydrophilic property held.

[0220] When the grade of contamination on the front face of a substrate was light, the same effect was acquired, even if it did not perform oxygen plasma treatment but CF4 quantity of gas flow performed CF4 plasma treatment for 30 to 60 minutes on the conditions of 900SCCM(s), power 1.0 W/cm2, and pressure 1torr.

[0221] At the process shown in drawing 24 D, the filter layer of R, G, B, and three colors is formed by carrying out the regurgitation of red light-transmission pigment ink 316, green light transparency pigment ink 317, and the blue light-transmission pigment ink 318 to a predetermined pixel, more nearly respectively than the ink-jet head 319. Since the contact angle on the plasma treatment resin BM front face of pigment ink 317, 318, and 319 is 60 degrees or more, high definition patterning without color mixture of it becomes possible.

[0222] Moreover, you may use the substrate in which the bank which consists of two-layer [which made the lower layer material from which a contact angle with pigment ink becomes 20 - 50 degrees by the aforementioned plasma treatment] was formed. Fear of color omission thickness unevenness is avoidable.

[0223] (11): Use and explain a drawing to the surface-treatment method row concerning the 11th example of the 11th example this invention about the thin film forming method.

[0224] Drawing 25 A - 25D is drawing having shown the effect at the time of forming a bank by two-layer [of an inorganic substance and the organic substance].

[0225] At the process shown in drawing 25 A, a lower layer forms the laminating bank where glass 321 and the upper layer consist of a polyimide 322 by the FOTORISO method on ITO basis 3 board 20.

[0226] At the process shown in drawing 25 B, oxygen plasma and fluorine plasma treatment as shown in the octavus - the 10th example are performed continuously. An ITO substrate front face and a bank lower layer glass front face are hydrophilicity-ized, and the bank upper polyimide is ******(ed).

[0227] At the process shown in drawing 25 C, the thin-film-material liquid of a property which is different in the crevice which adjoins by carrying out the regurgitation of thin-film-material ink A; 327 and the thin-film-material ink B; 328 from the ink-jet head 326 is applied. The contact angle on the front face 323 of ITO to thin-film-material ink shows the contact angle of 90 degrees in the bank upper polyimide front face 325 30 to 40 degrees on the bank lower layer glass front face 324 20 or less degrees after plasma treatment.

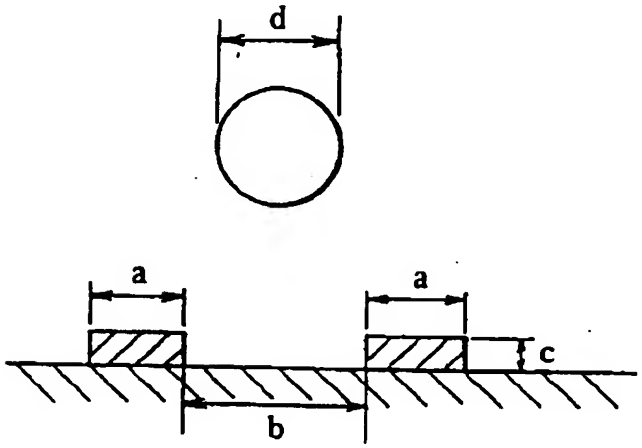
[0228] As shown in drawing 25 D after baking, a thin film A; 329 and a thin film B; 330 are obtained. Since the plasma treatment polyimide front face 325 shows strong ** ink nature, it may not be formed evenly around the bank skirt which consists of a polyimide as shown in drawing. However, the circumference of the lower layer bank skirt in which both the ITO front face 323 and the glass front face 324 were formed with glass for parent ink nature is also formed, and a flat film is formed on an ITO front face. In the case of the element which has the structure which sandwiches an organic thin film by ITO(s), such as an organic EL element, and the electrode, the short circuit which takes place since the film is not formed on ITO can be prevented. Moreover, it is very effective in order to prevent the color nonuniformity by thickness nonuniformity in manufacture of a light filter.

[0229] As mentioned above, according to the octavus - the 11th example, after performing oxygen gas plasma treatment to the substrate which has the bank formed with the organic substance on the same substrate, liquid repellance semipermanent on a bank can be given to it by performing fluorine system gas plasma treatment after this, with the lyophilic on the front face of a substrate held.

[0230] Moreover, according to the above-mentioned method, the pattern by which surface energy was controlled can be formed on the same substrate by the simple method, and the paint film method not only by the applying methods, such as the conventional spin coat, but the ink-jet method enables it to carry out patterning membrane formation of the thin-film-material liquid precisely. Therefore, about manufacture of a light filter or full color organic EL equipment, there are not color mixture, color nonuniformity, and a cross talk, and it becomes possible a low cost and to manufacture simple.

[Translation done.]

Drawing selection [R pr sentativ drawing]



[Translation done.]

JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

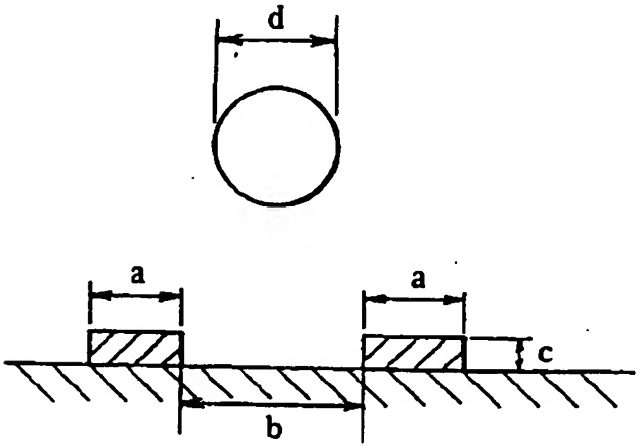
TECHNICAL FIELD

[The technical field to which invention belongs] The substrate for thin film patterning and its surface treatment this invention relate to the thin film coating technology suitable for manufacture of the display, such as EL (electroluminescence) element and a Light Emitting Diode (light emitting diode) element, or the light filter which used the organic-semiconductor film.

[0002] It is related with the substrate for carrying out patterning membrane formation of the thin film from which properties, such as a full color organic EL (electroluminescence) element and a light filter, differ especially on the same substrate, the thin film formation method, and a thin film. Moreover, that it is easy to form a thin film layer with an ink-jet method, a flat thin film layer can be formed and it is related with the thin film formation method which needs detailed patterning. Furthermore, it is related with the display equipped with the surface-treatment method for carrying out patterning restoration of the thin-film-material liquid with high definition on the ink-jet method or a spin coat, the method of forming a thin film using this surface-treatment method, and this thin film to the field surrounded on the bank formed on the substrate, and its manufacture method.

[Translation done.]

Drawing selection [Representativ drawing]



[Translation done.]

JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

TECHNICAL PROBLEM

[Description of the Prior Art] In recent years, the thin film from which a property differs in the same substrate is formed by the predetermined pattern by application, and the technology in which it obtains a functional device is developed. Formation of a different thin film pattern on the same substrate is made by the ink-jet method as the leading method. However, in the case where an ink-jet method is used, the problem in the process side that a different thin film material on a substrate is mixed arises. Although the technology which paints thin film materials, such as an organic semiconductor material in display, such as an EL element, and a coloring resin in a light filter, using an ink-jet method is specifically used, when it is filled up with liquid material using an ink-jet method and forms the pattern of a thin film, the problem of flowing into the pixel which the breathed-out liquid material adjoins has arisen.
[0004] The convex batch member (called a "bank" or "heights") into which a different thin film field is usually divided is prepared to such a problem, and the method filled up with the liquid material used as a thin film which is different to the field surrounded by this batch member is taken. In the example of the above-mentioned display device, the batch member into which each coloring matter field is divided is prepared, and the method of filling up the field surrounded in each batch field with the material which constitutes a pixel is taken.
[0005] generally in the latest functional device, especially display, thinness requires -- having -- a batch -- in spite of restricting the height of a member according to it, the field surrounded by the batch member is far filled up with a lot of liquid material as compared with the volume after film production
[0006] for this reason, the size of the drop breathed out by the field surrounded by the batch member and a batch -- a member -- a problem arises from the unsavoriness of balance with the area of the field surrounded by a front face and this This problem is explained below.
[0007] a batch -- a member -- it should be filled up -- a thin film material -- it is -- a liquid -- material -- receiving -- a lyophilic -- or -- wettability -- having -- if -- a case -- a diaphragm -- it is -- even if -- a diaphragm -- pulling -- having -- the field of a request in a final thin film to which liquid material adjoins easily if thickness cannot be obtained and the amount of liquid material is made [many] -- flowing out .
[0008] On the other hand, the front face of the field surrounded by the diaphragm needs to have high compatibility and wettability to liquid material so that liquid material may get wet uniformly in this and it may spread. Otherwise, to the field surrounded by the batch member, liquid material will get wet, and will not spread, but the color omission and irregular color in a pixel will arise in a display device like especially an EL element.
[0009] such a problem -- receiving -- JP,9-203803,A and JP,9-230129,A -- a batch -- the technology which makes the upper part of a member liquid repellance, and carries out surface treatment so that the other portion may become lyophilic is proposed
[0010] these conventional examples -- both -- a batch -- the layer which forms in the upper surface of a member the layer (layer which consists of a fluorine compound) which consists of a

liquid repellance material, and shows non-compatibility to JP,9-203803,A -- a batch -- it applies to the upper part of a member and the technology of processing the front face of the field surrounded by the batch member with a hydrophilic radical surfactant is indicated The technology which makes compatibility the crevice further surrounded by UV irradiation by the batch member is indicated by JP,9-230129,A. The logical consideration is indicated by International Display ResearchConference 1997 and pp 238-241.

[0011] however, it can set on the aforementioned conventional technology -- as -- a batch -- a member -- ****** the lyophilic of the field surrounded by liquid repellance on top and the batch member is realized to some extent for example, the size of the drop breathed out when applying liquid material using an ink-jet method and the above-mentioned batch -- a member -- extremely large to the area of the field surrounded by a front face and this -- it is -- it is -- when these balance was remarkable and bad, a coated field was not correctly filled up with liquid material, but the bird clapper understood it that patterning with a high precision is impossible that it was small etc. if the size of for example, the above-mentioned drop changes too much more greatly than the field surrounded by the batch member -- a drop -- a batch -- a member -- a top -- running aground -- further -- a batch -- a member -- when an up front face is narrow, a drop will overflow to the field contiguous to the coated field made into the purpose

[0012] Thus, when the relation between the size of a drop and the area of the field surrounded by a batch member and this is not fitness, dispersion in thickness will be produced for every mixture of the thin-film-material liquid between the fields which originated in the above problems and were surrounded by the batch member, or thin film to form.

[0013] Moreover, in case the field divided by the batch member is filled up with a thin film material, a problem is also further produced about the compatibility over the thin-film-material liquid of a diaphragm.

[0014] The behavior of the thin-film-material liquid with which the field surrounded by the batch member or the batch member was filled up with what wettability (compatibility) is shown to thin-film-material liquid differs. it mentioned already -- as -- a batch -- if the front face of a member shows compatibility (hydrophilic property) to thin-film-material liquid -- a batch -- when filled up with the material of the amount exceeding the height of a member, even if there is a batch member, thin-film-material liquid will flow into the field surrounded by the batch member which adjoins easily conversely, a batch -- if the front face of a member shows non-compatibility (water repellence) moderately to thin-film-material liquid -- a batch -- even if filled up with the material of the amount exceeding the height of a member, thin-film-material liquid does not flow into the field surrounded by the surface tension of material by the next batch member

[0015] And it is manufacture of the light filter of the front face concerned in order to acquire a specific property as reforming on the more concrete front face of a substrate. For example, it is JP,9-203803,A mentioned already, JP,9-230129,A, and the thing further indicated by JP,9-230127,A, i.e., the method of carrying out ** ink processing of the bank front face with a fluorine system compound, and parent ink processing is raised by the technology (JP,9-203803,A) of processing the field surrounded on a bank with the surfactant which has a hydrophilic radical, the method (JP,9-230127,A) of processing by etching, or energy irradiation (JP,9-230129,A).

[0016] however -- especially -- fluorine system compound material -- using -- a member -- when making a front face into ** ink nature, or when forming a member using fluorine system compound material, adhesion with the ground layer or the ground substrate which forms the aforementioned fluorine system material and a member becomes bad, and when application is considered to the technology which forms a bank on a substrate, there is a problem Moreover, there is a possibility that a residue may arise to a bank field and the parent ink nature on the front face of a bank may be spoiled, after patterning by photo lithography though a member,

especially the bank itself are able to be formed with the fluorine system compound material of ** ink nature etc.

[0017] moreover -- the above-mentioned well-known technology -- a batch -- a member -- only in order to make the upper part into non-compatibility, the application of the material which shows non-compatibility, dryness, removal, etc. could not but be needed, and the number of processes could not but increase Moreover, in performing UV irradiation, there is an inclination which serves as compatibility with much material. Even if material was non-compatibility material, it came to produce compatibility a little by UV irradiation, and there was an inclination for non-compatibility processing of **** to become useless. Although the purport which controls the grade of compatibility by irradiating ultraviolet rays from both sides of the front reverse side was especially specified to JP,9-230129,A, about how the contact angle to control of the compatibility of non-compatibility and compatibility, for example, thin-film-material liquid, is set up, respectively, it was unknown.

[0018] moreover, a batch -- case the liquid repellance of a member is strong -- a batch -- since the liquid of a thin film material is crawled by the side attachment wall of a member, the thickness after membrane formation becomes it is thick and thin in the center section of the field surrounded by the batch member at a periphery Now, the irregular color in a pixel arises in a display device. It leads to the fall of reliability that it is especially easy to produce short-circuit in an EL element.

[0019] a batch -- the case where performed **** processing on the surface of the member, and compatibility (lyophilic) is given to the side although there is nothing with a bird clapper thinly around the field where the thin film material was offered and the thickness after membrane formation was surrounded by the batch member -- the great portion of liquid of a thin film material -- a batch -- since it is pulled by the side of a member, thickness not only becomes larger in the skirt portion of a thin film, i.e., the portion which touches a substrate, but a bird clapper does not have control of thickness as it is difficult

[0020] As the reforming method of the surface energy (wettability) of an organic substance, performing plasma treatment is known well. As such a surface-treatment method, there are some which are indicated by JP,63-308920,A, for example. The surface-treatment method indicated by this official report controls the surface energy of the aforementioned organic substance by processing an organic substance front face using the mixed-gas plasma containing fluorine system gas and oxygen gas, and changing the mixing ratio of the aforementioned mixed gas.

[0021] Moreover, in order to hydrophilicity-ize inorganic substance front faces, such as glass and ITO (Indium Tin Oxide), it is the technique by which how to carry out UV irradiation and oxygen plasma treatment was also learned well.

[0022] However, when preparing the pattern of the layer which consists of the organic substance or an inorganic substance on the same substrate, the technology which controls the wettability of each material by plasma treatment or UV irradiation simple and strictly in this substrate is not reported. the member formed with an organic substance front face or the organic substance of mixed-gas plasma treatment -- by the method of giving ** ink nature to a front face, when surface ** ink nature is transient, it passes like a heat process or time passes [**** / that ** ink nature cannot be given efficiently], there is a problem that ** ink nature deteriorates

[0023] Moreover, it is difficult for there to be a possibility of spoiling the ** ink nature on the front face of a bank, and to attain simultaneously the ** ink nature on the front face of a bank, and the parent ink nature on the front face of a bank by energy irradiation, when performing parent ink processing.

[0024] Thus, in the method of supplying a different thin film material, filling up with thin-film-material liquid the field surrounded by the method of forming the thin film of a predetermined pattern, especially the batch member (bank) formed on the substrate, and

forming a thin film, it is important to control appropriately the wettability (** ink nature and parent ink nature) of a bank and a crevice. If there is no ** ink nature in a bank, when being filled up with thin-film-material liquid which is different in the crevice which it not only produces an ink residue, but adjoins across a bank on a bank, thin-film-material liquid which overcomes this bank and is different will be mix d mutually. If such a case arises, the thin film which has a desired property cannot be formed.

[0025] Although a color organic EL element, the light filter used for a liquid crystal display are mentioned as an example which forms a thin film using thin-film-material liquid which is different on the other hand in the crevice which adjoins across a bank, when manufacturing these, the field, i.e., ITO and glass-substrate front face, top which a bank is ** ink nature and are surrounded on a bank must be parent ink nature. If there is no parent ink nature in a crevice, the wetting breadth within a pixel will cause a color omission and thickness nonuniformity bad.

[0026] Furthermore, by the above-mentioned method, in addition to ** ink processing, parent ink down stream processing of a pixel field, i.e., a crevice, is needed, and it has the difficulty that the things and the process that control of the ink to supply is difficult will increase, further.

[0027] this invention is finished under such a situation. When carrying out patterning membrane formation of the thin film from which a property differs on the same substrate, a thin-film-material liquid prevents the situation of flowing out across a bank, and this invention can form certainly the thin film layer of the stable property without the irregular color of flatness and uniform thickness etc. with the sufficient yield highly precise comparatively easily, and sets it as the main purposes to make high definition detailed patterning possible.

[0028] In case the 1st purpose of this invention forms thin films, such as an organic semiconductor material and a coloring resin, with regurgitation methods, such as an ink-jet method and a bubble jet (registered trademark) method, it is to offer thin films to which mixture in every thin film field did not take place, but patterning of the dispersion in thickness was carried out with high precision remarkably few, such as an organic EL element and a light filter. Moreover, this purpose is accompanied and this invention also makes it the purpose to offer the substrate for thin film patterning with which manufacturing this thin film is presented, the display equipped with this thin film, and the thin film formation method for obtaining this thin film further.

[0029] Furthermore, in case the 2nd purpose of this invention forms electric conduction thin films, such as wiring of a semiconductor device, an electron device, etc., by the spin coat method or the dipping method, it is to offer the substrate thin film which makes still more detailed patterning possible, the thin film formation method, the thin film formed by this method, the display equipped with this thin film, and electronic equipment equipped with this display, respectively.

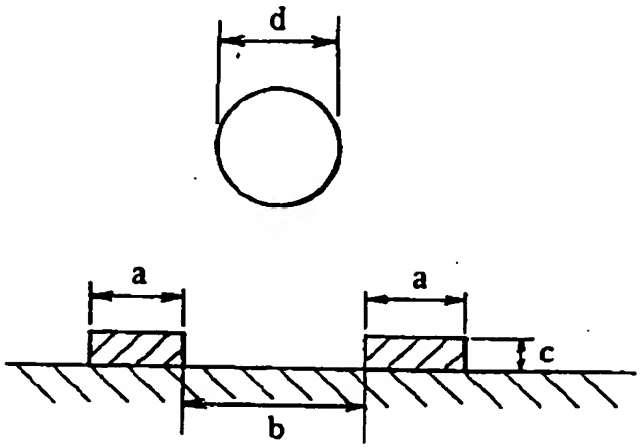
[0030] The 3rd purpose of this invention is offering a display device and display equipped with the surface-treatment method of the substrate the bank's aiming at wettability simple and suitable control having been formed, the method of forming a thin film using this surface-treatment method, and this thin film, and these manufacture methods.

[0031] The bank itself is offering the thin film formation method which can control the compatibility of a bank and a bank forming face certainly in the 4th purpose of this invention managing plasma treatment on fixed conditions, without passing through many processes for compatibility control, maintaining high adhesion with a bank forming face. It is this preventing thin-film-material liquid flowing out across a bank, raising the yield, and decreasing a manufacturing cost.

[0032] The 5th purpose of this invention is offering the display which can prevent thin-film-material liquid flowing out across a bank, and has the thin film layer of uniform thickness by setting up the compatibility of a bank and a bank forming face certainly by managing plasma tr atment on fixed conditions. It is being able to perform by this image display which produces unevenness neither in a luminosity nor a color, and raising reliability.

[Translation done.]

Drawing selection [Representative drawing]



[Translation done.]

JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

MEANS

[Means for Solving the Problem] In the thin film formation using the regurgitation method as stated above in order that this invention persons may attain the 1st purpose of the above, as a result of repeating research wholeheartedly the above-mentioned batch to liquid material -- a member -- it not only adjusts the lyophilic of the field surrounded by surface liquid repellance and the batch member, but with the size of the drop of the liquid material breathed out further a batch -- by optimizing a relation with the area of the field surrounded by the member and this batch member, it finds out that the 1st purpose of the above-mentioned this invention can be attained

[0034] Moreover, in addition to wettability control of the field surrounded by the aforementioned diaphragm and diaphragm to liquid material, in the thin film formation using the spin coat method or the dipping method, it finds out that the 2nd purpose of the above-mentioned this invention can be attained by adjusting the surface tension of this liquid material to a specific value. this invention is completed based on this knowledge.

[0035] In order to attain the 1st purpose of the above, this invention Namely, the bank of height predetermined to a substrate top, And it is the display device formed in the thin film patterning substrate which forms the pattern of a thin film layer in the coated field divided by this bank by the ink-jet method, or this patterning substrate. When setting to d (micrometer) the diameter of a drop of the liquid material which sets width of face of the above-mentioned bank to a (micrometer), sets the height to c (micrometer), and sets width of face of a coated field to b (micrometer), and forms a thin film layer, the above-mentioned bank is characterized by having the following property.

[0036] (1) It is formed on a substrate and a bank becomes so that d / 2< b<5d may be satisfied. By fulfilling this property range, liquid material does not run aground on a bank, but the color mixture in a pixel is prevented. Furthermore, at least one of the following properties is added to this property.

[0037] (2) a>d/4 : If b becomes a>d/4 when small, although liquid material may run aground on a bank, mixture of the thin film material in a coated field will be prevented.

[0038] (3) c>t0 [t0 (micrometer) is thickness [of a thin film layer]].

(4) c>d/(2b)

In addition, although the above-mentioned parameters a and c become fixed in the case of a stripe or a square coated field, when a pixel is a circle, Parameter a is a curtate distance between pixels, and Parameter c becomes a diameter.

[0039] The bank of predetermined height where this invention for attaining the 2nd purpose of the above was formed on the substrate, In the thin film which is constituted and becomes so that it may have the coated field divided by this bank and the thin film layer formed in this field by the dipping method or the spin coat method Using the substrate by which predetermined surface treatment (wettability control) was made, surface tension forms the aforementioned thin film layer using the liquid material of 30 or less dyne/cm, and it is characterized by the bird

clapper.
[0040] By making surface tension of liquid material into this range, formation of a patterning thin film is attained by the spin coat method or the dipping method by width of face of several microns or less.
[0041] In this invention, the thin film formation method for obtaining these thin films, the display equipped with this thin film as a display device, and electronic equipment equipped with this display are proposed further.
[0042] As what attains the purpose of the 3rd henceforth of the above, the invention concept common to invention which this invention person could make and which is mentioned later It is the surface-treatment method for filling up with thin film formation material the field surrounded in the substrate on the bank. A series of surface-treatment processings are uniformly performed on all the substrate front faces in which the bank was formed. The non-compatibility over the thin film formation material of a bank partial front face by this processing of a series of It is the display using display devices, such as an EL element using the surface-treatment technology of having the process raised to it of the front face of the portion between banks, the thin film coating technology using this surface-treatment technology, the thin film patterning substrate using this, or this, or this element.
[0043] As opposed to it giving the mask after OK and bank formation for the bank pattern by which surface treatment was carried out by carrying out patterning, and performing surface treatment, after the conventional example as stated above gives a water-repellent finish all over the photoresist top before patterning According to this this invention, as a series of processings are performed almost uniformly for the whole surface and the process of the different species [surface treatment] in the middle of surface treatment, such as plasma treatment, does not involve, the target surface treatment on the front face of a substrate which has the bank formed beforehand can be performed at a stretch. Here, a series of surface-treatment processings are processings which apply the below-mentioned plasma treatment to the substrate in which the bank which becomes the bank forming face which consisted of inorganic material from an organic material was formed at a stretch suitably like the after-mentioned.
[0044] Then, the bank formation process which forms a bank in the bank forming face which invention which attains the 3rd purpose of the above is the surface-treatment method for filling up with thin film formation material the field surrounded in the substrate on the bank, and consists of inorganic material by the organic material, When predetermined surface treatment is performed, a bank is characterized by having the surface treatment process which performs surface treatment to a bank and a bank forming face under fixed conditions to which the grade of non-compatibility over thin-film-material liquid becomes higher compared with a bank forming face.
[0045] Furthermore, the bank formation process which forms a bank in the bank forming face which other gestalten of this invention are the thin film formation methods which fill up with thin-film-material liquid the field surrounded on the bank, and form a thin film layer in it, and consists of inorganic material by the organic material, The surface treatment process to which a bank performs surface treatment to a bank and a bank forming face under fixed conditions to which the grade of non-compatibility over thin-film-material liquid becomes higher compared with a bank forming face when predetermined surface treatment is performed, It is characterized by having the thin film stratification process which fills up with thin-film-material liquid the field surrounded on the bank where surface treatment was carried out, and forms a thin film layer in it.
[0046] the batch which prepares in order to divide with a bank here as stated above (for example, the pixel of the display using the organic-semiconductor thin film), or is prepared in order to divide the pixel field of a light filter -- the thing of a member is said Even if a bank forming face is a field which prepares this bank and are drive substrates, such as display, they may be transparent substrates, such as a light filter, etc.

[0047] As surface treatment, the gas which contained the fluorine or the fluorine compound in introductory gas, for example is used, and the reduced pressure plasma treatment and atmospheric pressure plasma treatment which carry out plasma irradiation under reduced pressure atmosphere and atmospheric pressure atmosphere are performed. It is mentioned that plasma treatment is performed in the gas containing a fluorine system compound and oxygen as fixed conditions. Under these conditions, on the surface of inorganic material, an unreacted machine is generated by plasma electric discharge, an unreacted machine oxidizes by oxygen and polar groups, such as a carbonyl group and a hydroxyl group, occur. A polar group shows compatibility to the fluid containing polar molecules, such as water, and shows non-compatibility to the fluid containing the nonpolar molecule. The phenomenon in which a fluorine system compound molecule enters an organic material-list side in parallel to the above reactions also in an organic material-list side is also produced. When the content of a fluorine system compound and the fluorine system compound to the total amount of oxygen is set up to 60% or more when there are more especially fluorine system compounds than oxygen for example, since the mixing-ized phenomenon of a fluorine system compound prospers rather than the oxidation reaction by oxygen, by gas atmosphere-ization with the excessive amount of a fluorine system compound, a front face is un-polarized by the mixing-ized phenomenon rather than the influence by oxidation reaction. Therefore, when a fluorine system compound carries out plasma treatment of the organic material on excessive conditions, non-compatibility is shown to the fluid containing the polar molecule, and compatibility comes to be shown to the fluid containing the nonpolar molecule.

[0048] As gas containing the fluorine or the fluorine compound, the halogen gas of CF4, SF6, and CHF3 grade is used, for example. If surface treatment is performed under these conditions, the compatibility of the front face will be adjusted so that the contact angles to a fluid may differ greatly between an organic material and inorganic material. The conditions of surface treatment are set up so that the contact angle to the bank forming face of thin-film-material liquid may become 20 or less degrees with the above-mentioned surface treatment. Moreover, the conditions of surface treatment are set up so that the contact angle to the bank forming fac of thin-film-material liquid may become 50 degrees or more. When a bank is formed by the bilayer, by surface treatment, the compatibility over the thin-film-material liquid of a bank lower layer is less than [it of a pixel electrode], and is set up more than it of the bank upper layer. For example, the conditions of surface treatment are set up so that a contact angle may become [the front face of the bank upper layer] 50 or less degrees to thin-film-material liquid. The conditions of surface treatment are set up so that the front face of a bank lower layer may become the range whose contact angle is 20 degrees or 40 degrees to thin-film-material liquid.

[0049] It is decided whether to be compatibility here or be non-compatibility by with what property the thin-film-material liquid with which it is filled up is equipped. For example, if it is thin-film-material liquid with a hydrophilic property, the front face which has a polar group shows compatibility, and the front face which has a nonpolar group shows non-compatibility. Conversely, if it is thin-film-material liquid with lipophilic property, the front face which has a polar group shows non-compatibility, and the front face which has a nonpolar group shows compatibility. for manufacture, it will boil variously as what a thin film material is used, it will change, and will apply

[0050] Preferably, a bank formation process forms a bank by the upper layer and the lower layer bilayer. This bank formation process is equipped with the lower layer film formation process which forms a lower layer film in a bank forming face, the upper formation process which forms the upper layer according to the formation field of a bank on a lower layer film, and the removal process which **********s and removes the lower layer film of the field in which the upper layer concerned is not prepared by using the upper layer as a mask as an example.

[0051] Moreover, as another example, by setting the lower layer film concerned by the lower layer film formation process which forms a lower layer film in a bank forming face to the

formation field of a bank lower layer, a bank formation process sets the upper film concerned by exposure, the process to develop, and the upper film formation process which covers a lower layer and forms the upper film to the formation field of the bank upper layer, and is equipped with exposure and the process to d velop.

[0052] A pixel electrode is prepared in the field surrounded as an example of application on a bank, and the case where it is an organic semiconductor material for thin-film-material liquid forming a thin film light emitting device is mentioned. This is organic-semiconductor display. At this time, for example, a pixel electrode, it is an ITO electrode layer. As for a bank, specifically, it is desirable that they are insulating organic materials, such as a polyimide. Moreover, in preparing a bank lower layer, it uses a silicon oxide, a silicon nitride, or an amorphous silicon.

[0053] this invention which furthermore attains the 4th purpose of the above is the surface-treatment method for filling up with thin-film-material liquid the field surrounded on the bank formed on the substrate, and offers the surface-treatment method which equipped the substrate in which the bank was formed with the first process which performs oxygen plasma treatment, and the second process which performs fluorine system gas plasma treatment after this.

[0054] According to this method, the front face of inorganic substance substrates, such as glass and ITO, can be first made into a lyophilic (compatibility) to the aforementioned thin-film-material liquid by oxygen gas plasma treatment.

[0055] The oxygen plasma treatment performed at the first process of the above is effective in order to perform efficiently ****** by the fluorine system gas plasma treatment it not only carries out ashing of the residue at the time of forming a bank with the organic substance on a substrate, but continuously performed by activating an organic substance front face.

[0056] By performing fluorine system gas plasma treatment at the second process of the above, the fluoridation (Teflon-izing) of the organic substance front face is carried out, and it can give semipermanent liquid repellance to the organic substance. The lyophilic on a substrate is not spoiled by this fluorine system gas plasma treatment, and a lyophilic and a liquid repellance front face can be alternatively formed on the same substrate by the simple method.

[0057] Moreover, let plasma treatment of either the first process of the above, and the second process at least be the atmospheric pressure plasma processed under atmospheric pressure. Or let plasma treatment of either the first process of the above, and the second process at least be the reduced pressure plasma processed under reduced pressure.

[0058] Moreover, if the grade of contamination on a substrate is low, only fluorine plasma treatment is. With reduced pressure plasma, especially a substrate front face is washed and can Teflon-ize the organic substance which forms a bank.

[0059] The aforementioned substrate can consist of inorganic substances. The parent liquefaction of the substrate front face which consists of this inorganic substance can also be carried out.

[0060] On the bank formed on the aforementioned substrate, the upper surface of this bank can be formed with the organic substance at least. Or on the bank formed on the aforementioned substrate, the upper surface and the side of this bank can also be formed with the organic substance. On the bank formed on the aforementioned substrate, the bank concerned can also be formed by two-layer [of a lower layer inorganic substance and the upper organic substance] further again. Moreover, the bank concerned is formed by two-layer [of a lower layer inorganic substance and the upper organic substance], and even if there are few inorganic substances concerned, it can avoid wearing the side with this organic substance on the bank formed on the aforementioned substrate.

[0061] Moreover, the organic substance front face which forms the aforementioned bank can be made into ****** (non-compatibility). And the organic substance front face which forms the aforementioned bank can also be Teflon-ized again. The parent liquefaction of the substrate front face which ****** the organic substance front face which forms the aforementioned bank

further again, and consists of the aforementioned inorganic substance can also be carried out.
[0062] Since it is not necessary to use a liquid repellance material for the organic material which forms a bank from the first, the width of face of material selection spreads.
[0063] Moreover, surface energy (a lyophilic, liquid repellance) is easily controllable by conditions, such as the processing time, a kind of gas, a quantity of gas flow, plasma intensity, a plasma electrode, and substrate distance.
[0064] A contact angle [as opposed to the aforementioned bank front face for the contact angle to the aforementioned substrate front face of the aforementioned thin-film-material liquid] can be made 30 or less degrees at 50 degrees or more.
[0065] If the contact angle to the substrate front face of the aforementioned thin-film-material liquid exceeds 30 degrees, on the substrate surrounded on the bank, thin-film-material liquid will be uniformly [there are no whole surface ****** or] damp, and will not spread, but will produce thickness nonuniformity. On the other hand, thin-film-material liquid will adhere also to the bank upper part with a low from 50 degrees, or the contact angle to the aforementioned bank front face of the aforementioned thin-film-material liquid will flow out in the substrate which is pulled at a bank side and adjoins across a bank. That is, patterning to the place of a request of the aforementioned thin-film-material liquid will become impossible.
[0066] Moreover, by forming a bank from two-layer, using inorganic material for a lower layer, and controlling to become 20 - 50 degrees with a contact angle, or the film does not stick at the bank skirt, the problem which becomes thin is solvable.
[0067] Therefore, it becomes possible to carry out patterning of the thin-film-material liquid to the field surrounded by the above-mentioned surface-treatment method on the bank with high precision by the paint film methods, such as the ink-jet method or a spin coat. If the thin film forming method by the substrate and the ink-jet method for having performed the above-mentioned surface treatment is used, it will become possible to manufacture a full color organic EL element in a simple and light-filter row high definition at a low cost.
[0068] Furthermore, this invention which attains the 5th purpose fills up with thin-film-material liquid the field surrounded on the bank formed on the substrate, is the method of forming a thin film, and offers the thin film formation method equipped with the process which fills up immediately with the aforementioned thin-film-material liquid the field surrounded on the bank of a substrate where the surface treatment mentioned above was given with an ink-jet method after the surface treatment concerned.
[0069] Moreover, ** which attains the 5th purpose, and this invention fill up with thin-film-material liquid the field surrounded on the bank formed on the substrate, are the method of forming a thin film, and offer the thin film formation method equipped with the process which fills up immediately with the aforementioned thin-film-material liquid the field surrounded on the bank of a substrate where the surface treatment mentioned above was given by the spin coat method or the dipping method after the surface treatment concerned.
[0070] In order to attain the 5th purpose, this invention offers the display equipped with the thin film formed by the thin film formation method mentioned above further again. A bird clapper can do this display from a light filter and an organic EL element.
[0071] Moreover, this invention offers the manufacture method of the display which forms a thin film by the thin film formation method mentioned above in order to attain the 5th purpose.
[0072]
[Embodiments of the Invention] Below, the 1st which carried out invention of a claim according to claim 1 to 29 - the 3rd example, and its modification are explained.
[0073] (1): The 1st example (mode using the ink-jet method)
In the display which has the thin film layer by which the display of this invention is formed in the substrate front face divided by the predetermined bank and this predetermined bank of height on the substrate by the ink-jet method When setting to d (micrometer) the diameter of a drop of the liquid material which sets width of face of the above-mentioned bank to a (micrometer),

sets the height to c (micrometer), and sets to b (micrometer) width of face of the coated field divided into the above-mentioned bank, and forms a thin film layer, The above-mentioned bank is a>d/4, d / 2< b<5d, and c>t0. [t0 (micrometer) is formed on a substrate so that thickness [of a thin film layer]] and each formula of c>(1/2) x (d/b) may be satisfied.

[0074] Drawing 1 is a ** type view for explaining the relation of the bank and drop which were prepared in the substrate at the time of forming the display of this invention by the ink-jet method.

[0075] (a) Say the batch member prepared in order that the bank (called heights or a diaphragm) prepared on the substrate used for the display of the composition this invention of a bank may divide the pixel of the display using for example, the full color organic EL element, or the pixel field of a light filter. If width of face of the above-mentioned bank is set to a (micrometer) as shown in drawing 1 , the value is required when performing a uniform application, without it being full of the pixel field to which liquid material adjoins to the diameter d of a drop of the regurgitation liquid in the ink-jet method (micrometer) that it is a>d/4, i.e., a larger value than the quadrant of the diameter of a drop.

[0076] Although the height is prepared as c (micrometer) on a substrate, a bank The value is the thickness t0 of the thin film layer which it is going to form. (micrometer) When width of face of the below-mentioned large coated field is set to b (micrometer) It is desirable to prepare so that it may become c>(1/2) x (d/b), i.e., a larger value than 1/2 of the ratio of the diameter of a drop and the width of face of a coated field, when attaining the purpose of this invention. When it takes into consideration that as thin the one of surface element as possible is desirable, c is 2 microns or less.

[0077] In this invention, when liquid material overflows on the occasion of the application in the ink-jet method to the pixel field which adjoins when applying simultaneously the coloring matter or organic-semiconductor luminescent material of three colors of red, green, and blue, in order to avoid that color mixture arises, it is desirable to prepare predetermined ****** in a bank front face. A thing as the thing on the front face of up of a bank for which ****** is preferably prepared in a part for a center section in the shape of a slot is desirable and shows to drawing 2 as the configuration is illustrated. That is, although drawing 2 A - 2C is the cross section of the bank which has the above-mentioned ******, the cross section of drawing 2 A is the thing of a V character configuration, drawing 2 B is a concave-like thing, and drawing 2 C is the thing of U configuration or a semi-sphere configuration.

[0078] Though liquid material overflows from the target pixel in case it applies by the ink-jet method by preparing such ******, it is regarded by ******, and though a drop runs aground on a bank, it is similarly regarded by ******. Consequently, the color mixture of a display device is avoidable.

[0079] It is a member which functions as a batch member, ****** (Teflon-izing) by plasma treatment is possible for a bank, and its insulating organic materials, such as a polyimide which adhesion with a ground substrate is good and patterning by the photolithography tends to carry out, are desirable so that the material which shows liquid repellance to liquid material may be sufficient and it may mention later. A batch member may make a cover function make it serve a double purpose in a light filter. In order to form as a covered member, the material for black matrices uses metals and oxides, such as chromium.

[0080] Formation of a bank can be performed by arbitrary methods, such as the lithography method and print processes. For example, when using the lithography method, according to the height of a bank, an organic material is applied by predetermined methods, such as a spin coat, a spray coat, a roll coat, a die coat, and a DIP coat, and a resist layer is applied on it. And it leaves the resist doubled with the bank configuration by giving a mask according to a bank configuration, and exposing and developing a resist. It **********s at the end and the bank material of portions other than a mask is removed. Moreover, you may form a bank (heights) above two-layer [by which the lower layer was constituted from an inorganic substance and

the upper layer was constituted from the organic substance].
[0081] (b) The composition bank of a substrate is formed on a substrate. Although you may be the transparent substrate used for a light filter even if it is the drive substrate in which the TFT (TFT:Thin Film Transistor) used for display was formed as a substrate, it is desirable that the front face is formed by the member with high adhesion with a bank. It is desirable to consist of inorganic material especially at the point of acquiring suitable compatibility in the below-mentioned surface treatment. ITO(s) which are transparent electrodes as such a thing if it is display are glass, a quartz, etc. if it is a light filter, and it is **********.
[0082] (c) The display of the composition this invention of a coated field and a thin film layer has the substrate front face divided by the above-mentioned bank, i.e., the thin film layer which used liquid material for the coated field by the ink-jet method, and was formed in it. It is as [substrate / which forms the above-mentioned coated field] above-mentioned. In this invention, when setting to d (micrometer) the diameter of an ink-jet drop of the liquid material which forms a thin film layer, it is required to make width of face b of a coated field (micrometer) into the value of the range of d / 2< b<5d. When the values of b are below d/2 (micrometer), a drop is full of a coated field, and the problem of a drop running aground on a bank, even if it flows into the pixel field which adjoins through a bank or liquid repellance is in a bank arises. Moreover, when the value of b is more than 5d (micrometer), although it spreads to a coated field, in order for thickness to become thin and to obtain desired thickness, the overprint of multiple times is needed and uneconomical [a drop]. Moreover, depending on the case, it may get wet uniformly and may not spread.
[0083] In this invention, if the above-mentioned coated field has the above-mentioned size Although there is especially no limit about the configuration and any configurations, such as a square (a rectangle, a square, and a rhombus are included), polygons (five square shapes, six square shapes, etc.), and a configuration similar to annular configurations, such as being circular (a perfect circle form and an ellipse form being included), a cross, and these other, are possible In the application method by the ink-jet method, that to which it made this edge section the curved surface from the desirable thing that it is the configuration in which a drop tends to get wet in the thing of a configuration which has the edge section (for example, the corner and the vertex section in a square) especially is desirable. It can be made easy to wet the above-mentioned edge portion wet, when liquid material is filled up into a coated field with doing in this way.
[0084] Although liquid material is applied to the above-mentioned coated field and a thin film layer is prepared, as the example of application, there is organic EL display, in here, a thin film layer is a pixel electrode, and liquid material is an organic semiconductor material for forming a thin film light emitting device. In this case, for example, the above-mentioned pixel electrode, it is an ITO electrode layer.
[0085] (d) In a surface treatment this invention, it is desirable that a bank front face performs surface treatment to the substrate material of a bank and a coated field so that the grade of non-compatibility over liquid material may become higher compared with a coated field. It is desirable to make the contact angle to the bank front face of liquid material into 50 degrees or more with such surface treatment, and to make the contact angle to the substrate material of a coated field into 20 or less degrees. Only a predetermined coated field is filled up without liquid material's overcoming a bank and overflowing, even if it breathes out a lot of liquid material by doing in this way compared with thin film layer thickness.
[0086] As the above-mentioned surface treatment, the gas which contains a fluorine or a fluorine compound in introductory gas, for example is used, and the reduced pressure plasma treatment and atmospheric pressure plasma treatment which carry out plasma irradiation under the reduced pressure atmosphere containing a fluorine compound and oxygen or atmospheric pressure atmosphere are mentioned. As gas containing a fluorine or a fluorine compound, CF4, SF6, and CHF3 grade are mentioned.

[0087] (e) In a thin film formation this invention, apply liquid material to the coated field divided on the above-mentioned bank by the ink-jet method, and form a thin film layer in it. By using the ink-jet method, restoration becomes possible with small equipment which can fill up liquid material into arbitrary coated fields with arbitrary amounts, and is used for a home printer. In this invention, by optimizing the configuration of the coated field divided into a bank and this bank, and a size to the path d of the drop breathed out (micrometer), color mixture with the next pixel does not happen, but a thin film layer without dispersion in the thickness for every pixel is obtained.

[0088] Discharge quantity in the ink-jet method is taken as an amount which becomes desired thickness, when volume decreases by heat-treatment after an application. You may carry out superposition processing after dryness so that it may become desired thickness by the case. Viscosity is usually Number cP making it breathe out from an ink-jet formula recording head.

[0089] A predetermined coated field will be filled up in this invention, without liquid material's overcoming a bank and overflowing, even if it breathes out a lot of liquid material by specifying the size of a bank, and the width of face of a coated field to the size of the breathed-out drop compared with thin film layer thickness. After being filled up with liquid material, in the case of the material containing a solvent, by performing heat-treatment and/or reduced pressure processing, and removing a solvent component, the volume of liquid material decreases and a thin film layer is formed in a coated field. At this time, since surface treatment of the front face, i.e., substrate front face, of a coated field is carried out so that a lyophilic may be shown as mentioned above, a thin film layer sticks it suitably. As a liquid material which can be used, as for the case of display, an organic semiconductor material can use the charge of a coloring matter etc. again, as for the case of a light filter. An organic luminescent material which has luminescence chosen from red, green, and blue as an organic semiconductor material, for example is used.

[0090] In addition, although all of the method of carrying out the regurgitation by gassing by heat can be used as an ink-jet method even if it is a piezo jet method, a piezo jet method is desirable at a point without transformation of the fluid by heating.

[0091] (2): The 2nd example (mode using the dipping method or the spin coat method)
In the display with which this invention persons have the thin film layer which is divided by the predetermined bank and this predetermined bank of height, prepares a coated field, performs desired surface treatment, and is formed by the dipping method or the spin coat method on a substrate Also by the thin film formation method that the above-mentioned thin film layer is characterized by forming surface tension using the liquid material of 30 dyne/cm, it found out that the purpose of this invention was attained. Even if in addition to the surface energy of a bank and a substrate especially the above-mentioned display attains the above-mentioned purpose and compares it with the describing [above] ink-jet method by controlling the surface energy of liquid material, without adding limitation to the configuration or size of a bank or a coated field in any way unlike the case of the application which used the ink-jet method, it makes still more detailed patterning possible. by controlling in the range of the above-mentioned surface tension especially, it will be used effective in detailed patterning, such as metal wiring, and several micrometer piece patterning becomes possible Moreover, it is effective when using material with the hole-injection layer common to R, G, and B used for organic EL-element manufacture.

[0092] About the substrate used here, a bank, and coated field material, the quality of the material is the same as that of the case of the application which used the describing [above] ink-jet method. Moreover, it is desirable to perform the surface treatment same to a bank front face and a coated field as the case of the ink-jet method. Therefore, as for the substrate which are a bank and a coated field, it is desirable respectively that it is what has the contact angle of 50 degrees or more and 30 degrees or less to liquid material. Each of the dipping method and the spin coat method can be performed by the method usually performed in this industry.

[0093] (3): The 3rd example (concrete operation gestalt of display)
The concrete composition of the display of this invention is explained below.
[0094] (Composition) Drawing 3 is the block diagram showing typically the layout of the whole active matrix type display in this operation gestalt. Drawing 4 is the plan showing one of the pixels in drawing 3 , a cross section [in / cutting plane A-A of drawing 4 / in respectively drawing 5 A - 5C], a cross section in cutting plane B-B, and a cross section in cutting plane C-C.
[0095] The active matrix type display of this operation gestalt equips a part for the center section of the transparent substrate 10 with the display 11. The data side drive circuit 3 and the scan side drive circuit 4 are established in the periphery portion of the transparent substrate 10, from the data side drive circuit 3, the data line sig is wired by the display 11 and the scanning line gate is wired from the scan side drive circuit 4. The complementary type TFT is constituted from these drive circuits 3 and 4 by TFT of N type and TFT of P type which are not illustrated. This complementary type TFT constitutes the shift register circuit, the level-shifter circuit, the analog switch circuit, etc., and constitutes the data signal and scanning signal which are supplied from the outside possible [power amplification].
[0096] Two or more pixels 7 are arranged on the transparent substrate 10 like the active matrix substrate of liquid crystal active matrix type display at the display 11. Two or more scanning lines gate and two or more data lines sig cross, the drive circuits 3 and 4 or ** is wired, and the data line sig and the scanning line gate of a lot are allotted to each pixel 7. The common feeder com other than the data line sig which crosses in the shape of a matrix, and the scanning line gate is wired through near which is each pixel.
[0097] Each pixel 7 is a bank (bank). It is formed in the circular crevice with a diameter of 50 micrometers surrounded in the layer. The width of face a is 10 micrometers, height is 2 micrometers, and the material of the bank layer which divides a pixel is as above-mentioned. Moreover, as a liquid material (what diluted the PPV precursor solution with DMF, the glycerol, and the diethylene glycol, and ink-ized it), organic semiconductor-material solutions, such as the poly (parlor phenylenevinylene) (PPV) precursor solution, are used. The organic-semiconductor film 43 is formed by breathing out and heating this liquid material to the coated field surrounded by the ink-jet method on the bank. Moreover, you may be the laminated structure which formed conductive material, such as polyethylene dioxythiophene, from the ink-jet method or the spin coat method as a hole-injection transporting bed.
[0098] Each pixel 7 is equipped with the flow control circuit 50 and the thin film light emitting device 40. The flow control circuit 50 is equipped with 1st TFT20, retention volume cap, and 2nd TFT30. As for 1st TFT20, the scanning signal is supplied to the gate electrode through the scanning line gate. Retention volume cap is constituted possible [maintenance of the picture signal supplied from the data line sig through 1st TFT20]. The picture signal by which 2nd TFT30 was held with retention volume cap is supplied to the gate electrode. The series connection of the 2nd TFT30 and thin film light emitting device 40 is carried out between Counterelectrode op and the common feeder com.
[0099] 1st TFT20 and 2nd TFT30 are formed with the island-like semiconductor film, as shown in drawing 4 and drawing 5 A - 5C. As for 1st TFT20, the gate electrode 21 is constituted as a part of scanning line gate. The data line sig is electrically connected to one side of the source drain field through the contact hole of an insulator layer 51 between the 1st layer, and, as for 1st TFT20, the drain electrode 22 is electrically connected to another side. As for the drain electrode 22, the gate electrode 31 of 2nd TFT30 is electrically connected through the contact hole of an insulator layer 51 between the 1st layer. The relay electrode 35 by which simultaneous formation of 2nd TFT30 was carried out with the data line sig through the contact hole of an insulator layer 51 at one side of the source drain field between the 1st layer is connected electrically. The transparent electrode 41 of the thin film light emitting device 40 is electrically connected to the relay electrode 35 through the contact hole of an insulator layer

52 between the 2nd layer. ITO is used as a transparent electrode.
[0100] As for 2nd TFT30, the common feeder com is electrically connected to another side of the source drain field through the contact hole of an insulator layer 51 between the 1st layer. To the installation portion 36 of the gate electrode 31 of 2nd TFT30, the installation portion 39 of the common feeder com counters on both sides of an insulator layer 51 as a dielectric film between the 1st layer, and constitutes retention volume cap. In addition, about retention volume cap, you may form between the scanning line gate besides the above-mentioned structure formed between the common feeders com, and the capacity line formed in parallel. Moreover, you may constitute retention volume cap using the drain field of 1st TFT20, and the gate electrode 31 of 2nd TFT30.
[0101] The thin film light emitting device 40 surrounded in the bank layer is formed independently every pixel 7. The thin film light emitting device 40 carries out the laminating of the organic-semiconductor film 43 and the counterelectrode op to order as a luminescence thin film, and is formed in the upper layer side of the pixel electrode 41. As an organic-semiconductor film 43, the material which emits light by impression of electric field, for example, poly, (parlor phenylene) (PPV) is used. In addition, the organic-semiconductor film 43 is formed for every pixel, and also it may be formed in the stripe configuration over two or more pixels 7. Metal membranes, such as a conductive material which reflects light, for example, lithium content aluminum, and calcium, are used for Counterelectrode op. Counterelectrode op is formed in the field except the display 11 whole and the field in which the terminal 12 is formed at least.
[0102] In addition, you may adopt the structure in which the both sides of the structure which prepared the hole-injection layer as mentioned above, and raised luminous efficiency (hole-injection efficiency) as the above-mentioned thin film light emitting device 40, the structure which prepared the electron-injection layer and raised luminous efficiency (electron-injection efficiency), a hole-injection layer, and an electron-injection layer were formed.
[0103] (The manufacture method of display) Next, the manufacture method of the active matrix type display of the above-mentioned composition is explained.
[0104] Semiconductor stratification process: After forming the ground protective coat to which it is thin from the silicon oxide which is about 2000-5000A by the plasma CVD method to the transparent substrate 10 first if needed by making TEOS (tetrapod ethoxy silane), oxygen gas, etc. into material gas, the semiconductor film on which it is thin by the plasma CVD method from the amorphous silicon film which is about 300-700A is formed in the front face of a ground protective coat. Next, to the semiconductor film which consists of an amorphous silicon film, crystallization processes, such as laser annealing or a fixed grown method, are performed, and a semiconductor film is crystallized on a polysilicon contest film. Next, the gate insulator layer 37 to which patterning of the semiconductor film is carried out, and it considers as an island-like semiconductor film, and is thin by the plasma CVD method to the front face from the silicon oxide or nitride which is about 600-1500A by making TEOS (tetrapod ethoxy silane), oxygen gas, etc. into material gas is formed. Next, after forming the electric conduction film which consists of metal membranes, such as aluminum, a tantalum, molybdenum, titanium, and a tungsten, by the spatter, patterning is carried out, and the installation portions 36 of the gate electrodes 21 and 31 and the gate electrode 31 are formed. The scanning line gate is formed in this process.
[0105] In this state, high-concentration phosphorus ion is driven in and a source drain field is formed in a self-adjustment target to the gate electrodes 21 and 31. In addition, the portion into which an impurity was not introduced serves as a channel field. Next, after forming an insulator layer 51 between the 1st layer, each contact hole is formed and the installation portions 39 of data-line sig, the drain electrode 22, the common feeder com, and the common feeder com and the relay electrode 35 are formed. Consequently, 1st TFT20, 2nd TFT30, and retention volume cap are formed.

[0106] Next, an insulator layer 52 is formed between the 2nd layer, and a contact hole is formed in the portion which is equivalent to this layer insulation film at the relay electrode 35. Next, after forming an ITO film in the whole front face of an insulator layer 52 between the 2nd layer, patterning is carried out, through a contact hole, it connects with the source drain field of 2nd TFT30 electrically, and the pixel electrode 42 is formed in it every pixel 7.
[0107] Insulator layer formation process: Next, an insulator layer 62 is formed along with the scanning line gate and the data line sig. An insulator layer 62 consists of organic insulating materials, such as the aforementioned polyimide. An insulator layer 62 chooses the value which optimized liquid material as the width of face and thickness to the diameter of a drop at the time of applying by the ink-jet method as mentioned above.
[0108] Surface treatment process: Plasma treatment is performed as mentioned above using the gas which subsequently contains a fluorine that an insulator layer 62 should be set for the front face of the pixel electrode 41 or more to 50 by non-compatibility, for example, a contact angle, to liquid material 20 or less to liquid material by compatibility (it is a hydrophilic property when liquid material contains moisture), for example, a contact angle.
[0109] Organic-semiconductor (organic EL element) film formation process: Form each organic-semiconductor film 43 corresponding to R, G, and B in the coated field divided by the circle configuration by the bank after the above-mentioned surface treatment using the ink-jet method. That is, the regurgitation of the liquid material which is the material for constituting the organic-semiconductor film 43 from an ink-jet formula recording head to the coated field of the circle configuration surrounded by the bank layer is carried out. As an example, the thing which doped coloring matter, such as a rhodamine and BERIREN, or the thing which ink-ized the PPV precursor (MHE-PPV) was used for what ink-ized the above-mentioned PPV precursor as a red luminous layer material. What dissolved in aromatic system solvents, such as a xylene, and ink-ized the poly fluorene derivative as a material for a blue luminous layer was used. The diameter of a drop was 30micrometerphi.
[0110] Subsequently, in the case of a PPV precursor solution (what carried out DMF dilution and ink-ized the PPV precursor solution), remove a solvent under reduced pressure, it is made to conjugate it by 150-degree Centigrade heat-treatment, is fixed to a coated field, and forms the organic-semiconductor film 43. here, since the size and configuration of a bank layer and a coated field are set as the value optimized to 30 micrometers of diameters phi of a drop of the liquid material breathed out, the application field of the organic-semiconductor film 43 is certainly prescribed by the bank layer, and it does not see and come out of it to the adjoining pixel 7 And since a bank layer has non-compatibility to liquid material and a coated field has compatibility to liquid material, liquid material does not adhere to a bank side attachment wall. Consequently, the organic-semiconductor film 43 formed after heat treatment holds uniform thickness on every pixel electrode and a pixel electrode.
[0111] In addition, what is necessary is just to repeat the restoration and dryness of liquid material by the ink-jet method for each class, in forming a multilayer-structure element, when carrying out the laminating of a luminous layer, a hole-injection layer, the electron-injection layer, etc. and forming them as an organic-semiconductor film. Or if it adjusts also in spin coat processing and DIP processing by making surface tension of liquid material into 30 or less dyn/cm when material with a hole-injection layer and an electron-injection layer common to R, G, and B can be used, it is possible to carry out pattern formation only to a pixel field. Although the polystyrene sulfonic acid was added into the hole-injection material (for example, the poly thiophene derivatives, such as polyethylene dioxythiophene) used for an organic EL element as an example, the water dispersion was diluted with the low alcoholic system of the surface tension of the low of surface tension, a Cellosolve system solvent, or a methanol, or other aqueous system solvents, and it prepared so that surface tension might become 30 or less dyne/cm.
[0112] This solution for spin coats showed the contact angle of 20 degrees or more on 60

degrees or more and the ITO front face to the bank which carried out surface treatment (plasma treatment).

[0113] If the organic-semiconductor film 43 is formed, Counterelectrode op will be formed all over the simultaneously of the transparent substrate 10, and active-matrix type display will be completed.

[0114] According to the above manufacture methods, since each organic-semiconductor film 43 corresponding to R, G, and B can be formed in a predetermined field using the ink-jet method, full color active-matrix type display can be manufactured for high productivity. And since an organic-semiconductor film can be formed by uniform thickness for every pixel, unevenness does not arise in a luminosity. Moreover, since the thickness of an organic-semiconductor film is uniform, the drive current of the thin film light emitting device 40 does not concentrate in part, and the fall of the reliability of the thin film light emitting device 40 can be prevented.

[0115] In addition, although TFT is formed also in the data side drive circuit 3 or the scan side drive circuit 4, such TFT uses all or a part of processes which forms TFT for a pixel 7, and is performed. So, TFT which constitutes a drive circuit will also be formed between the same layers as TFT of a pixel 7. Moreover, about 1st TFT20 and 2nd TFT30, although another side is [P type and one side / any of P type] satisfactory for N type and both sides at N type, even if both sides are which such combination, they can form TFT by the well-known method.

[0116] (Other modifications) In addition, without being limited to the above-mentioned embodiment, this invention can be variously changed within the limits of this invention, and can be carried out.

[0117] For example, this invention is applicable to a light filter. Drawing 6 is the cross section of an example of the light filter applied to this invention. in this case, the batch which formed as a bank the transparent substrate 300 which turns into a substrate from glass or a quartz with black material, such as a resin, -- the coloring resin 302 is used for a member 301 as a liquid material a batch -- as a member 301, you may form a black matrix with the application of black pigment and a color, a chrome oxide, a chromium metal membrane, etc. the transparent substrate 300 top -- a batch -- the ink-jet method after forming a member 301 -- a batch -- the crevice coated field 303 surrounded by the member 301 is filled up with the coloring resin 302 In addition, if it is the thing which filled up with arbitrary fluids the crevice surrounded by the member of an invoice, and was obtained, and its manufacture method, application of this invention is possible.

[0118] The width of face a of a bank and the width of face b of a coated field were changed as shown in the 1st table as an example, display as set height c of a bank to 2 micrometers and shown in drawing 6 was produced, and the diameter d of a drop applied to the coated field using the application liquid of 30 micrometerphi by the ink-jet method. The following error criteria estimate a result and it is shown in the 1st table. However, the other conditions were as follows.

Bank material: Polyimide (the laminated-structure bank of a SiO2+ polyimide is sufficient.)
Substrate material : ITO bank surface contact angle: 60 degrees (plasma treatment)
Coated field contact angle: 10 degrees (plasma treatment)
Liquid material: Poly para-phenylene vinylene precursor solution (what melted the PPV precursor in the solution which makes DMF a principal component, carried out little addition of a glycerol and the diethylene glycol, and was ink-ized)
Error-criterion O: The simultaneous regurgitation of R, G, and B which are completely settled in a crevice (drawing 7 D) is possible for a drop, without a residue remaining on a bank.

[0119]
O : Although a drop is settled in a crevice, a residue remains in a bank a little (drawing 7 C).
**: A drop will run aground on a bank. (Drawing 7 B)
Material remains on an after [dryness] bank. The simultaneous regurgitation of R, G, and B is impossible.

[0120] x: It overflows to the crevice where liquid material adjoins (drawing 7 A).
Though the wetting to which wetting does not spread completely in a crevice (drawing 7 E) spreads, since thickness is thin, several times of overprints are needed.
[0121]
[Table 1]

		a (μm)			
		5	10	20	30
b μm	10	×	×	△	△
	15	×	○	○	○
	20	○	○	○	○
	30	◎	◎	◎	◎
	50	◎	◎	◎	◎
	160	×	×	×	×

As mentioned above, as stated to the 1st – the 3rd example, and its modification in detail, in the ink-jet method, by fitness-izing the size of the bank to the diameter of a drop of liquid material, and a coated field, there is no color mixture between pixels and the very few display of dispersion in the thickness for every pixel is obtained. Moreover, simultaneous patterning of R, G, and B also becomes possible.
[0122] Moreover, in the spin coat method or a dipping method, still more detailed patterning becomes possible by specifying the surface tension of liquid material.
[0123] In addition, even if it is except display or display, this invention is effective in the substrate which has the wiring used for these also in formation of an electron device, for example, a TFT element, and is applied effective in an organic EL element, display, or a light filter.
[0124] Then, the 4th which carried out invention of a claim according to claim 30 to 48 – the 7th example, and its modification are explained.
[0125] (4): The 4th example of the 4th example this invention is related with the thin film formation method at the time of forming a bank with single material. The manufacturing process cross section of this example is shown in drawing 8 A – 8D. this example is applied to all uses that fill up with a predetermined fluid the field which established the bank in the bank forming face in arbitrary configurations, and was divided on the bank. For example, when filling up a coloring resin into a pixel field with the case where an organic semiconductor material is filled up with the display device using the organic-semiconductor thin film into a pixel field, or a light filter, it can apply.
[0126] Bank formation process (drawing 8 A) : A bank formation process is a process which forms a bank in a bank forming face. Even if a bank forming face is the drive substrate in which the TFT (TFT:Thin Film Transistor) used for display was formed, it may be a transparent substrate used for a light filter. a batch -- a member -- if it is the purpose which fills up with a

fluid the field surrounded on a bank, and forms a thin film in it, there will be no limitation in the structure of a bank forming fac However, it is desirable that the front face is formed by the member with high adhesion with a bank. It is desirable in order that consisting of especially inorganic material may acquire suitable compatibility with next surface treatment. It consists of glass, a quartz, etc., if ITO which is a transparent electrode if it is display is a light filter.

[0127] A bank may be a member which functions as a batch member, for example, it may be desirable to consist of insulating organic materials, such as a polyimide, and the material may have insulation, a property as a semiconductor, and conductive any. It is desirable in order that consisting of especially organic materials may acquire suitable non-compatibility with next surface treatment. A batch member may make a cover function make it serve a double purpose in a light filter. In order to form as a covered member, the material for black matrices uses metals and oxides, such as chromium. Formation of a bank can choose arbitrary methods, such as the lithography method and print processes. When using the lithography method, according to the height of a bank, an organic material is applied by predetermined methods, such as a spin coat, a spray code, a roll coat, a die coat, and a DIP coat, and a resist layer is applied on it. And it leaves the resist doubled with the bank configuration by giving a mask according to a bank configuration, and exposing and developing a resist. It **********s at the end and the bank material of portions other than a mask is removed. When using print processes, an organic material is directly applied to a bank configuration by arbitrary methods, such as intaglio printing, lithography, and letterpress. Even if the height of a bank 110 fills up with thin-film-material liquid the crevice 101 surrounded on a bank, it is formed in the crevice which adjoins with surface tension at the height which is the grade to which thin-film-material liquid does not overflow. For example, the oak and bank 110 which form the thin film layer 204 after heat-treatment by the thickness of 0.05 micrometers - 0.2 micrometers are formed in a height of 1 micrometer - about 2 micrometers.

[0128] Surface treatment process (drawing 8 B) : A surface treatment process is a process which performs plasma treatment under fixed conditions and adjusts the compatibility over the thin-film-material liquid of the bank forming face 100 and a bank 110. In the plasma treatment of this invention, the gas which contains a fluorine as introductory gas is used. Even if it is the reduced pressure plasma treatment under reduced pressure atmosphere, you may be the atmospheric pressure plasma treatment under atmospheric pressure atmosphere. It is desirable that the oxygen of a constant rate is contained in reactant gas. As a fluorine system compound, the halogen gas of CF4, SF6, and CHF3 grade is used.

[0129] It can know whether a front face shows wetting, a cone, and whether it is hard to get wet or compatibility is shown and non-compatibility to arbitrary fluids, such as thin-film-material liquid, by measuring the contact angle to the fluid of a material-list side. When plasma treatment of an organic material and the inorganic material is carried out to drawing 9 , drawing which measured how a contact angle would change with the mixing ratio of a fluorine compound and oxygen is shown. This measurement performed plasma treatment as stated above to the front face of the substrate which formed a polyimide, ITO, or SiO2 in the whole surface, and was performed by measuring the contact angle about the following ink.

[0130] About the substrate in which the polyimide film was formed, PPV precursor ink (what made DMF the principal component for the precursor solution, carried out little addition of a glycerol and the diethylene glycol, diluted with the mixed solvent, and was ink-ized) was used.

[0131] About the substrate in which ITO or SiO2 was formed, a methanol, a glycerol, and ethoxy ethanol were added to the water dispersion of hole-injection material (what added the polystyrene sulfonic acid to polyethylene dioxythiophene), and what was ink-ized was used for it.

[0132] A contact angle is a contact angle to a fluid with the hydrophilic property of ink etc. CF4 is used as a fluorine system compound here, the polyimide is used as an organic material and SiO2 and ITO (Indium-Tin-Oxide) are used as inorganic material. As shown in drawing 9 , under

atmosphere where oxygen is excessive, an organic material and inorganic material do not have a big difference in the grade of a contact angle. However, if a fluorine system compound makes it excessive, the contact angle of an organic material will become large (it becomes non-compatibility). On the other hand, change of the contact angle of inorganic material is small. If oxygen is contained in reactant gas, a polar group will generate inorganic material and an organic material by the oxidation by oxygen. However, in order for a fluorine compound molecule to enter into an organic material that a fluorine system compound is excessive, it is thought that the influence of a polar group decreases relatively. Therefore, while a fluorine system compound controls by excessive conditions compared with oxygen, by carrying out plasma treatment, an organic material and each inorganic material can be set as a desired contact angle (compatibility) according to drawing 9 . especially -- best [of drawing 9] -- it is desirable to use a mixing ratio (CF4/CF4+O2=75%), or to introduce CF4 and helium mixed gas in atmospheric pressure in order to make the difference of both contact angle into the maximum

[0133] Reduced pressure plasma treatment or atmospheric pressure plasma treatment is performed so that a fluorine system compound may be made into introductory gas and oxygen may be mixed at a fixed rate from the above fact. For example, as shown in drawing 8 B, in capacity-coupling type plasma treatment, the above-mentioned gas is passed to a reaction chamber, the substrate which has the bank forming face 100 on an electrode is laid, and electric field are added from a power supply 200 between the electrodes 201 of another side. various a well-known method, for example, a direct current anodizing process, a RF method, an inductive-coupling form, a capacity-coupling form, microwave methods, methods of adding electric field and a magnetic field to **, etc. can be looked like [how to add the energy to a reaction chamber], and it can apply to it Surface treatment made into arbitrary contact angles according to drawing 9 with the mixing ratio of the fluorine system compound and oxygen by plasma treatment is performed.

[0134] Surface treatment is carried out so that the degree of affinity to the thin-film-material liquid of the bank forming face 100 (base of a crevice 101) and a bank 110 may become the turn of a "bank forming face >> bank front face" with the surface treatment concerned.

[0135] Thin film formation process (drawing 8 C, 8D): A thin film formation process is a process which fills up with thin-film-material liquid 203 the crevice 101 surrounded on the bank 110, and forms a thin film layer in it. After restoration of thin-film-material liquid 203 evaporates a solvent component by heat-treatment etc., and forms the thin film layer 204. It is desirable to be based on an ink-jet method as a method filled up with thin-film-material liquid. It is because according to the ink-jet method a fluid can be filled up into arbitrary positions with arbitrary amounts and it can fill up with small equipment which is used for a home printer.

[0136] As shown in drawing 8 C, the regurgitation of the thin-film-material liquid 203 is carried out to the crevice 101 surrounded on the bank 110 from the ink-jet formula recording head 202. Discharge quantity is taken as an amount which becomes desired thickness, when volume decreases by heat-treatment. Viscosity is usually several pc or less making it breathe out from an ink-jet formula recording head. The upper surface and the side of a bank 110 show moderate non-compatibility to thin-film-material liquid 203 with surface treatment. For this reason, it fills up, so that it rises in the position of S1, without surface tension's acting and thin-film-material liquid 203 overcoming a bank 110, even if it breathes out a lot of thin-film-material liquid 203 compared with the thickness of the thin film layer 204, as shown in drawing 8 D at the time of restoration. If filled up with thin-film-material liquid, heat-treatment etc. will be performed and a solvent component will be evaporated. When a solvent component evaporates, as shown in drawing 8 D, the volume of thin-film-material liquid 203 decreases, and the thin film layer 204 is formed in the bottom of a crevice 101. Since surface treatment of the bottom of the crevice 101 which is the bank forming face 100 at this time is carried out so that compatibility may be shown, the thin film layer 204 sticks it suitably. Moreover, if conditions are chosen so that a contact angle may not become large extremely in drawing 9 about the contact angle of a bank

110, the thin film layer 204 can be formed by almost uniform thickness, without crawling thin-film-material liquid 203 extremely by the side attachment wall of a bank 110. The amount of the thin-film-material liquid 203 breathed out is adjusted so that the thickness of the thin film layer 204 after formation may be set to 0.1 micrometers - about 2 micrometers.

[0137] In addition, as an ink-jet method, you may be the method of carrying out the regurgitation by gassing by heat also in a piezo jet method. The nozzle and the piezo-electric-crystal element are equipped with and constituted from a piezo jet method by the pressure room. If voltage is impressed to the piezo-electric-crystal element with which the fluid is filled up into the pressure room, a volume change will arise in a pressure room and the drop of a fluid will be breathed out from a nozzle. By the method which carries out the regurgitation by gassing, the heating element is prepared in the pressure room which passes to a nozzle. A heating element is made to generate heat, the fluid of the nozzle neighborhood is boiled, a foam is generated, and the regurgitation of the fluid is carried out by the cubical expansion. A piezo jet method is desirable at a point without transformation of the fluid by heating.

[0138] As described above, according to this example, a bank front face can carry out surface treatment of the bank forming face to non-compatibility at a stretch to thin-film-material liquid at compatibility by performing plasma treatment on the conditions which oxygen is mixing in a fluorine system compound. And the contact angle which shows the degree of compatibility according to a property as shown in drawing 9 can be set up easily. That is, the bank itself can control the compatibility of a bank and a bank forming face certainly, without passing through many processes like before for compatibility control, maintaining high adhesion with a bank forming face. It can prevent by this that thin-film-material liquid flows out across a bank, the yield can be raised, and a manufacturing cost can be decreased.

[0139] (5): The 5th example of the 5th example this invention is related with the thin film formation method at the time of forming a bank by the two-layer structure. The feature is that especially forms a lower layer by inorganic material, and it forms the upper layer by the organic material.

[0140] The manufacturing process cross section of this example is shown in drawing 10 A-10F. this example is applied to all uses that fill up with a predetermined fluid the field which established the bank in the bank forming face in arbitrary configurations, and was divided like the 4th example of the above on the bank. For example, when filling up a coloring resin into a pixel field with the case where an organic semiconductor material is filled up with the display device using the organic-semiconductor thin film into a pixel field, or a light filter, it can apply.

[0141] Lower layer film formation process (drawing 10 A) : A lower layer film formation process is a process which forms the lower layer film 120 in the bank forming face 100. About a bank forming face, it is the same as that of the 4th example of the above. It is desirable in order that consisting of inorganic material as a material of a lower layer film may acquire suitable non-compatibility with next surface treatment. Moreover, it is desirable that it is material with the sufficient bank forming face 100 and sufficient adhesion. For example, when the bank forming face is formed of ITO etc., it is possible to use the general silicon oxide (SiO2) and general silicon nitride as an insulator layer, and an amorphous silicon for the lower layer film 120. When such a material is used, the compatibility between the compatibility of the base of a crevice 101 and the compatibility of the bank upper layer 121 is acquired by plasma treatment. This compatibility is effective in order to fix thin-film-material liquid to crevice 101 base evenly. Formation of a lower layer film is performed by applying the above-mentioned inorganic material according to desired height by predetermined methods, such as for example, a spin coat, a spray code, a roll coat, a die coat, and a DIP coat. The height of the lower layer film 120 has a desirable grade almost equal to the height of the thin film layer 204. Since the lower layer film 120 has thin-film-material liquid 203 and a certain amount of compatibility, the wall surface and the thin-film-material liquid 203 of the lower layer film 120 stick it in process in which

thin-film-material liquid 203 is heat-treated. It is because the distortion of the front face of the thin film layer 204 produced when thin-film-material liquid 203 sticks to the wall surface of the lower layer film 120 can be abolished if the thickness of final thin-film-material liquid 203 and the height of the lower layer film 120 are made almost equal.

[0142] The upper formation process (drawing 10 B) : The upper formation process is a process which forms the bank upper layer 121 on the lower layer film 120. The organic material mentioned in the 4th example of the above as a material of the bank upper layer 121 is used. Using also [member / covered] is also possible. The bank upper layer 121 is alternatively formed in a field to form a bank in. Arbitrary methods, such as print processes and the lithography method, can be chosen. When using print processes, an organic material is directly applied to a bank configuration by arbitrary methods, such as intaglio printing, lithography, and letterpress. When using the lithography method, according to the height of the bank upper layer 121, an organic material is applied by predetermined methods, such as a spin coat, a spray code, a roll coat, a die coat, and a DIP coat, and a resist layer is applied on it. And it leaves the resist doubled with the bank configuration by giving a mask according to a bank configuration, and exposing and developing a resist. It **********s at the end and the material of the bank upper layer of portions other than a mask is removed. Even if the height of a bank 110 fills up with thin-film-material liquid the crevice 101 surrounded on a bank, it is formed in the crevice which adjoins with surface tension at the height which is the grade to which thin-film-material liquid does not overflow. For example, the oak which forms the thin film layer 204 after heat-treatment by the thickness of 0.05 micrometers - 0.2 micrometers, and the doubled height of the lower layer film 120 and the bank upper layer 121 are formed in 1 micrometer - about 2 micrometers.

[0143] Removal process (drawing 10 C) : A removal process is a process which **********s the lower layer film 120 by using the bank upper layer 121 as a mask. The bank upper layer 121 is an organic material, and can act as a resist. Therefore, only the lower layer film 120 can be alternatively **********ed by choosing etching material. For example, the bank upper layer 121 is formed beforehand more thickly than the thickness of a schedule, dry etching of the whole is carried out together with a lower layer film, or when the lower layer film 120 is formed by SiO2, wet etching of the fluoric acid is used and carried out to an etching reagent. Lower layer films 120 other than the bank formation field as for which the mask is carried out by this processing in the bank upper layer 121 are removed.

[0144] Surface treatment process (drawing 10 D) : A surface treatment process is a process which performs plasma treatment under fixed conditions and adjusts the compatibility over the bank forming face 100, the lower layer film 120, and the thin-film-material liquid of the bank upper layer 121. Plasma treatment of this invention is also performed by the same conditions and same gas as the above-mentioned operation gestalt 1. If the bank forming face 100 and the lower layer film 120 are especially chosen as ITO and SiO2, respectively, this surface treatment can perform a suitable compatibility setup. That is, since both ITO and SiO2 are inorganic material as shown in drawing 9 , although the change property by the mixing ratio of a fluorine system compound and oxygen is similar, the direction of SiO2 is in the inclination for the grade of compatibility to be high. For this reason, with the above-mentioned surface treatment, surface treatment of the grade of the compatibility of the bank forming face 100, the lower layer film (bank lower layer) 120, and the bank upper layer 121 can be carried out so that it may become the turn of the "bank forming face >= bank lower layer surface > bank upper front face."

[0145] Thin film formation process (drawing 10 E, 10F) : A thin film formation process is a process which fills up with thin-film-material liquid 203 the crevice 101 surrounded in the bank lower layer 120 and the upper layer 121, and forms a thin film layer in it. The detail is the same as the 4th example of the above. After restoration of thin-film-material liquid 203 evaporates a solvent component by heat-treatment tc., and forms the thin film layer 204.

[0146] As shown in drawing 10 E, the regurgitation of the thin-film-material liquid 203 is carried out to the crevice 101 surrounded on the bank from the ink-jet formula recording head 202. Discharge quantity is taken as an amount which becomes desired thickness, when volume decreases by heat-treatment. As for this thickness, it is desirable that it is almost equal to the thickness of the bank lower layer 120 by the reason for the above. It fills up, so that it rises in the position of S3, without the surface tension of the bank upper layer 121 acting, and thin-film-material liquid 203 overcoming a bank, even if it breathes out a lot of thin-film-material liquid 203 compared with the thickness of the thin film layer 204, as shown in drawing 10 E at the time of restoration. If filled up with thin-film-material liquid, heat-treatment etc. will be performed and a solvent component will be evaporated. When a solvent component evaporates, as shown in drawing 10 F, the volume of thin-film-material liquid 203 decreases, and the thin film layer 204 of thickness of the same grade as the bank lower layer 120 is formed by the thickness in surface S4 of the bottom of a crevice 101. Since surface treatment of the bottom of the crevice 101 which is the bank forming face 100 at this time is carried out so that compatibility may be shown, the thin film layer 204 gets wet suitably. Moreover, the contact angle of the bank lower layer 120 is smaller than the bank upper layer 121, and is stuck with thin-film-material liquid 203 by moderate compatibility. For this reason, thin-film-material liquid 203 is not crawled by the side attachment wall of the bank lower layer 120. Moreover, since the bank lower layer 120 and the thin film layer 204 are the almost same thickness, thin-film-material liquid 203 is not dragged by the side attachment wall of the bank lower layer 120. For this reason, the thin film layer 204 can be formed by almost uniform thickness. The amount of the thin-film-material liquid 203 breathed out is adjusted so that the thickness of the thin film layer 204 after formation may be set to 0.1 micrometers - about 2 micrometers.

[0147] As described above, according to this example, it can set up so that compatibility may go up to the bank which carried out the laminating of inorganic material and the organic material in order of the bank upper layer, a bank lower layer, and a bank forming face by performing plasma treatment on the conditions which oxygen is mixing in a fluorine system compound. That is, the bank itself can terminate surface treatment at a stretch by control of easy plasma treatment, without passing through many processes like before for compatibility control, maintaining high adhesion with a bank forming face. It can prevent by this that thin-film-material liquid flows out across a bank, the yield can be raised, and a manufacturing cost can be decreased. The effect that a uniform thin film layer can be formed especially is done so.

[0148] (6): The 6th example of the 6th example this invention forms a bank by the two-layer structure by different method from the 5th example of the above.

[0149] The manufacturing process cross section of this example is shown in drawing 11 A-11F, and drawing 12 A - 12 C. This operation gestalt is applied to all uses that fill up with a predetermined fluid the field which established the bank in the bank forming face in arbitrary configurations, and was divided like the 4th example of the above on the bank. For example, when filling up a coloring resin into a pixel field with the case where an organic semiconductor material is filled up with the display device using the organic-semiconductor thin film into a pixel field, or a light filter, it can apply. Since it is the same as that of the above 4th and the 5th example about the material about a bank forming face, a lower layer film, and the bank upper layer, or thickness, explanation is omitted.

[0150] Lower layer film formation process (drawing 11 A) : A lower layer film formation process is a process which forms the lower layer film 130 in the bank forming face 100. The lower layer film 130 is formed by the same method as the 5th example of the above.

[0151] Exposure process (drawing 11 B) : An exposure process is a process which carries out exposure development of the lower layer film 130 according to a bank configuration. According to a bank configuration, a mask 132 is formed in the upper part of the lower layer film 130. The mask of the case of the material which the lower layer film 130 hardens by energy grant is carried out so that a bank formation field may be made to penetrate light and a removal field

may not be made to penetrate light. In the case of the material into which the lower layer film 130 deteriorates possible [removal] by energy grant, the light of a bank formation field is intercepted, and it carries out a mask so that a removal field may be made to penetrate light. In this example, it is possible to change independently a bank configuration [in / eye the hatchet which can be etched, and a lower layer / for not the thing that **********s a lower layer by using the bank upper layer as a mask but a lower layer and the upper layer], and the bank configuration in the upper layer. By choosing the configuration of this bank lower layer as a suitable thing, a thin film layer can be suitably prepared now. In addition, energy sources, such as a laser beam, perform exposure using a well-known method.

[0152] Etching process (drawing 11 C) : An etching process is a process which leaves the field exposed and hardened and removes the lower layer film 130. A mask and the lower layer film 130 of a removal field are removed after exposure using a solvent. Etching uses fluoric acid as an etching reagent, when SiO2 and polysilazane are used as a lower layer film 130. Moreover, you may use dry etching.

[0153] The upper film formation process (drawing 11 D) : The upper film formation process is a process which covers the bank lower layer 130 and forms the upper film 130. The upper film 131 is formed by the same method as the above-mentioned lower layer film 130.

[0154] Exposure process (drawing 11 E) : An exposure process is a process which exposes the upper film 131 according to the upper bank configuration. According to the configuration of the bank upper layer, a mask 134 is formed on the upper film 131. The mask of the case of the material which the upper film 131 hardens by energy grant is carried out so that a bank formation field may be made to penetrate light and a removal field may not be made to penetrate light. In the case of the material into which the upper film 131 deteriorates possible [removal] by energy grant, the light of a bank formation field is intercepted, and it carries out a mask so that a removal field may be made to penetrate light. As mentioned above, with this operation gestalt, you may change the configuration of the bank upper layer 131 with a lower layer. In addition, energy sources, such as a laser beam, perform exposure using a well-known method.

[0155] Etching process (drawing 11 F) : An etching process is a process which leaves the field exposed and hardened and removes the upper film 131. A mask and the upper film 131 of a removal field are removed after exposure using a solvent. Etching uses fluoric acid as an etching reagent, when a polyimide is used as an upper film 131. Moreover, you may use dry etching.

[0156] Surface treatment process (drawing 12 A) : Since it is the same as that of the 5th example of the above about a surface treatment process, explanation is omitted. With this surface treatment, surface treatment of the grade of the compatibility of the bank forming face 100, the bank lower layer 130, and the bank upper layer 131 can be carried out so that it may become the turn of the "bank forming face >= bank lower layer surface > bank upper front face."

[0157] Thin film formation process (drawing 12 B, 12C) : A thin film formation process is a process which fills up with thin-film-material liquid 203 the crevice 101 surrounded in the bank lower layer 130 and the upper layer 131, and forms a thin film layer in it. Since it is the same as that of the 5th example of the above about a thin film formation process, explanation is omitted.

[0158] As described above, according to this example, it can set up so that compatibility may go up to the bank which carried out the laminating of inorganic material and the organic material in order of the bank upper layer, a bank lower layer, and a bank forming face by performing plasma treatment on the conditions which oxygen is mixing in a fluorine system compound. That is, the bank itself can terminate surface treatment at a stretch by control of easy plasma treatment, without passing through many proc sses like before for compatibility control, maintaining high adhesion with a bank forming face. It can prevent by this that thin-film-material liquid flows out across a bank, the yield can be raised, and a manufacturing cost can be decreased. The effect

that it can form in a configuration which can form a uniform thin film layer and is especially different in a bank lower layer and the upper layer is done so.

[0159] (7): The 7th example [7th] of an example is related with the display manufactured with the application of the 5th example mentioned above in actual display.

[0160] (Whole composition) It is the same as that of this display having changed with active-matrix type display, and drawing 3 mentioned above having explained the whole composition (for this reason, the sign of a component omits explanation of the duplication portion using the same thing as drawing 3). drawing 13 -- it -- constituting -- having -- **** -- a pixel -- one -- a ** -- extracting -- being shown -- a plan -- drawing 14 -- A - 14 -- C -- respectively -- drawing 13 -- a cutting plane -- A-A -- ' -- it can set -- a cross section -- a cutting plane -- B-B -- ' -- it can set -- a cross section -- and -- a cutting plane -- C-C -- ' -- it can set -- a cross section -- it is .

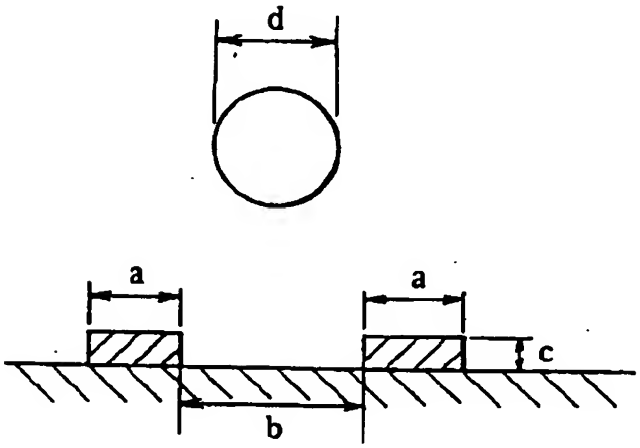
[0161] This active-matrix type display 1 is different in respect of the following, although the whole composition is the same as the thing of drawing 3 mentioned above, and equivalent.

[0162] That is, each pixel 7 is formed in the crevice surrounded in the bank layer bank. This bank layer carries out the laminating of the lower layer side insulator layer 61 and the upper layer side insulator layer 62, and is constituted. The operation gestalt 3 is applied to manufacture of this bank layer bank. About conditions, such as the material, height, etc., it is the same as that of the operation gestalt 3. An organic semiconductor material is used as thin-film-material liquid. The organic-semiconductor film 43 is formed by breathing out and heating this material to the field surrounded in the bank layer bank. For example, it is formed so that the organic-semiconductor film 43 may be set to 0.2 micrometers - about 1.0 micrometers and 1 micrometer - about 2 micrometers, respectively in the oak which is 0.05 micrometers - 0.2 micrometers, the lower layer side insulator layer 61, and the upper layer side insulator layer 62.

[0163] Moreover, 1st TFT20 and 2nd TFT30 are formed with the island-like semiconductor film, as shown in drawing 7 and drawing 8 . As an organic-semiconductor film 43, the material which emits light by impression of electric field, for example, a polyphenylene vinylene, (PPV) is used.

[Translation done.]

Drawing selection [Representative drawing]



[Translation done.]

JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

OPERATION

(Operation of a bank layer) In the above-mentioned composition, before the bank layer bank is filled up with the organic semiconductor material 203 with an ink-jet method, plasma treatment which made the fluorine or the fluorine compound introductory gas like the above-mentioned operation gestalt is carried out. For this reason, the compatibility over an organic semiconductor material is formed in the turn of insulating-layer 62 a pixel electrode 41>= lower layer side insulating-layer 62> upper layer side. For this reason, even if filled up with the thin-film-material liquid containing the organic semiconductor material to the limit of the pixel field surrounded in the bank layer bank, the organic-semiconductor film 43 can settle in the height of the lower layer side insulating layer 62, it can prevent that the organic-semiconductor film 43 solidifies in the shape of a concave letter, and the flat organic-semiconductor film 43 can be formed. Although the drive current of the thin film light emitting device 40 will concentrate there and the reliability of the thin film light emitting device 40 will fall when the thin portion of thickness is in the organic-semiconductor film 43, a title can be eliminated while it is such.

[0165] Moreover, in this example, the bank layer bank is formed also in the field which laps with the relay electrode 35 of the flow control circuit 50 among the formation fields of the pixel electrode 41, and the organic-semiconductor film 43 is not formed in the field which laps with the relay electrode 35. That is, the organic-semiconductor film 43 is formed only in a flat portion among the formation fields of the pixel electrode 41. It is the factor to which this also maintains the organic-semiconductor film 43 to fixed thickness.

[0166] Furthermore, if there is no bank layer bank in the field which laps with the relay electrode 35, also in this portion, between Counterelectrodes op, drive current will flow and the organic-semiconductor film 43 will emit light. However, this light is inserted between the relay electrode 35 and Counterelectrode op, and outgoing radiation is not carried out outside, and it does not contribute to a display. The drive current which flows in the portion which does not **** to this display can be called reactive current seen from the field of a display. However, with this gestalt, if it was the former, the bank layer bank was formed in the portion into which such the reactive current should flow. For this reason, it can prevent that useless current flows to the common feeder com, and the width of face of the common feeder com may come to be narrow that much. As the result, luminescence area can be increased and display performances, such as brightness and a contrast ratio, can be raised.

[0167] Moreover, patterning becomes possible, without having good control of striking a ball in any direction for every primary color, and using complicated processes, such as the photolithography method, by using an ink-jet method, since an organic-semiconductor film can be formed.

[0168] In addition, you may form the bank layer bank by the black resist. The bank layer bank functions as a black matrix, and its display grace, such as a contrast ratio, improves. That is, in the active-matrix type display 1 concerning this gestalt, since Counterelectrode op is formed in

the front-face side of the transparent substrate 10 all over a pixel 7, the reflected light in Counterelectrode op reduces a contrast ratio. However, if the blowout layer bank which b ars the function which lessens a parasitic capacitance is constituted from a black resist, since the bank layer bank can be operated as a black matrix and the reflected light from Counterelectrode op will be interrupted, a contrast ratio can be raised.

[0169] The bank layer bank is constituted along with the data line sig and the scanning line gate more thickly than the organic-semiconductor film 41, and Counterelectrode op is formed in this. Therefore, when the bank layer bank exists, it is prevented that a big capacity is parasitic on the data line sig. namely, the data line sig and Counterelectrode op -- since the thick bank layer bank intervenes in between [every], **** which is parasitic on the data line sig is very small So, the load of the drive circuits 3 and 4 can be reduced and low-power-izing and/or improvement in the speed of a display action can be attained.

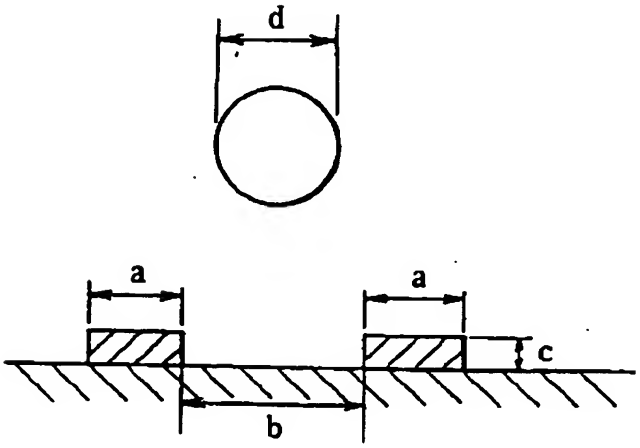
[0170] Moreover, the bank layer bank consists of the two-layer structure which consists of inorganic material and an organic material. If it is going to form a bank layer with thick thickness only by inorganic material, it is necessary to form the film which consists of inorganic material over long time by the PECVD method etc. On the other hand, organic materials, such as a resist and a polyimide film, are easy to form a comparatively thick film. Since the bank layer bank of this operation gestalt constitutes the upper layer side insulator layer 62 from an organic material with easy thick-film-izing, and the bank stratification can be managed in a short time, productivity can be raised.

[0171] Moreover, if it is this two-layer structure, although the organic-semiconductor film 41 has touched in the lower layer side insulator layer 61 which consists of inorganic material, it does not touch in the upper layer side insulator layer 62 which consists of an organic material. So, since the organic-semiconductor film 41 does not deteriorate in response to the influence of the upper layer side insulator layer 62 which consists of organic materials, in the thin film light emitting device 40, neither the decline in luminous efficiency nor the fall of reliability occurs.

[0172] Moreover, according to this example, since the bank layer bank is formed also in the boundary region (outside field of a display 11) of the transparent substrate 10, the data side drive circuit 3 and the scan side drive circuit 4 are also covered by the bank layer bank. If Counterelectrode op is formed in the display 11 at least, it is enough and it is not necessary to form it even in a drive circuit field. However, since doubling precision is bad when Counterelectrode op is formed by the mask spatter method, Counterelectrode op may be formed even in a drive circuit field. In this example, though Counterelectrode op is formed even in these drive circuit fields, the bank layer bank will intervene between the wiring layer of a drive circuit, and Counterelectrode op. For this reason, since it can prevent that capacity is parasitic on the drive circuits 3 and 4, the load of the drive circuits 3 and 4 can be reduced and low-power-izing and/or improvement in the speed of a display action can be attained.

[Translation done.]

Drawing selection [Representativ drawing]



[Translation done.]

JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

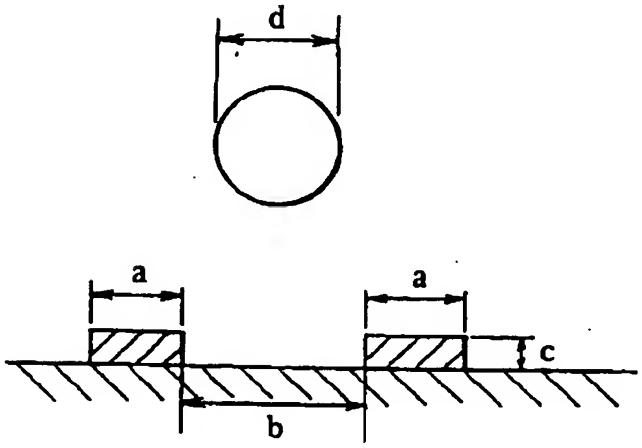
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is outline explanatory drawing showing the display of this invention, and the relation of a drop.
[Drawing 2] Drawing 2 A - 2C is the cross section showing the example of the configuration of a bank of having ****** in the display of this invention.
[Drawing 3] Drawing 3 is the block diagram showing typically the whole example layout of the active-matrix type display concerning the display of this invention.
[Drawing 4] Drawing 4 is the plan showing one of the pixels constituted by the active-matrix type display shown in drawing 3 .
[Drawing 5] Drawing 5 A - 5C is the A-A cross section of drawing 4 , a B-B cross section, and a C-C cross section, respectively.
[Drawing 6] Drawing 6 is the cross section of an example of the light filter which applied this invention.
[Drawing 7] It is the cross section showing each evaluation in drawing 7 A - 7E reference example.
[Drawing 8] Drawing 8 A - 8D is the manufacturing process cross section of the thin film formation method concerning the 4th example of this invention.
[Drawing 9] Drawing 9 is a property view explaining the relation between the mixing ratio of the fluorine system compound and oxygen concerning the principle of the surface treatment of this invention, and a contact angle.
[Drawing 10] Drawing 10 A-10F are the manufacturing process cross section of the thin film formation method concerning the 5th example of this invention.
[Drawing 11] Drawing 11 A-11F are the manufacturing process cross section of the thin film formation method concerning the 6th carried-out type of this invention.
[Drawing 12] Drawing 12 A - 12C is the manufacturing process cross section (continuation) of the thin film formation method concerning the 6th example of this invention.
[Drawing 13] Drawing 13 is the plan extracting and showing one of the pixels constituted by the active-matrix type display concerning the 7th example of this invention.
[Drawing 14] Drawing 14 A - 14C is the A-A' cross section and B-B'cross section and C-C' cross section of drawing 13 .
[Drawing 15] drawing 15 A - 15C explains a semiconductor stratification process -- it is the A-A' cross section and B-B'cross section and C-C' cross section of drawing 13 , respectively
[Drawing 16] drawing 16 A - 16C explains a lower layer side insulation stratification process -- it is the A-A' cross section and B-B'cross section and C-C' cross section of drawing 13 , respectively
[Drawing 17] drawing 17 A - 17C explains an upper layer side insulation stratification process -- it is the A-A' cross section and B-B'cross section and C-C' cross section of drawing 13 , respectively

[Drawing 18] drawing 18 A - 18C explains a bank stratification process -- it is the A-A' cross section and B-B'cross section and C-C' cross section of drawing 13 , respectively
[Drawing 19] drawing 19 A - 19C explains a surface treatment process -- it is the A-A' cross section and B-B'cross section and C-C' cross section of drawing 13 , respectively
[Drawing 20] drawing 20 A - 20C xplains an organic-semiconductor film formation process -- it is the A-A' cross section and B-B'cross section and C-C' cross section of drawing 13 , respectively
[Drawing 21] Drawing 21 is the cross section of the light filter which applied this invention.
[Drawing 22] Drawing 22 is drawing showing the contact angle change on the ITO substrate front face by the plasma treatment concerning the example of the octavus of this invention, and a polyimide film front face.
[Drawing 23] Drawing 23 is the process cross section showing the manufacture method of the organic EL element concerning the 9th example of this invention.
[Drawing 24] Drawing 24 is the process cross section showing the manufacture method of the light filter concerning the 10th example of this invention.
[Drawing 25] Drawing 25 is the process cross section showing the manufacture method which forms the bank concerning the 11th example of this invention by two-layer [of an inorganic substance and the organic substance].

[Translation done.]

Drawing selection [Representativ drawing]



[Translation done.]

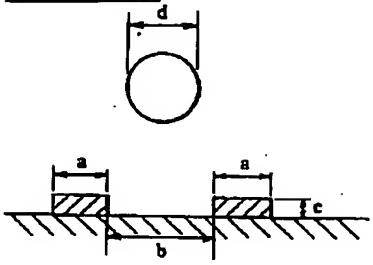
JAPANESE [JP,2000-353594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD TECHNICAL PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

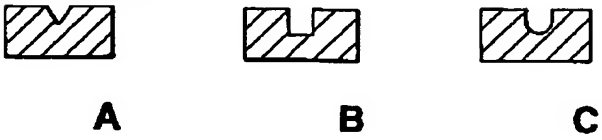
[Translation done.]

DRAWINGS

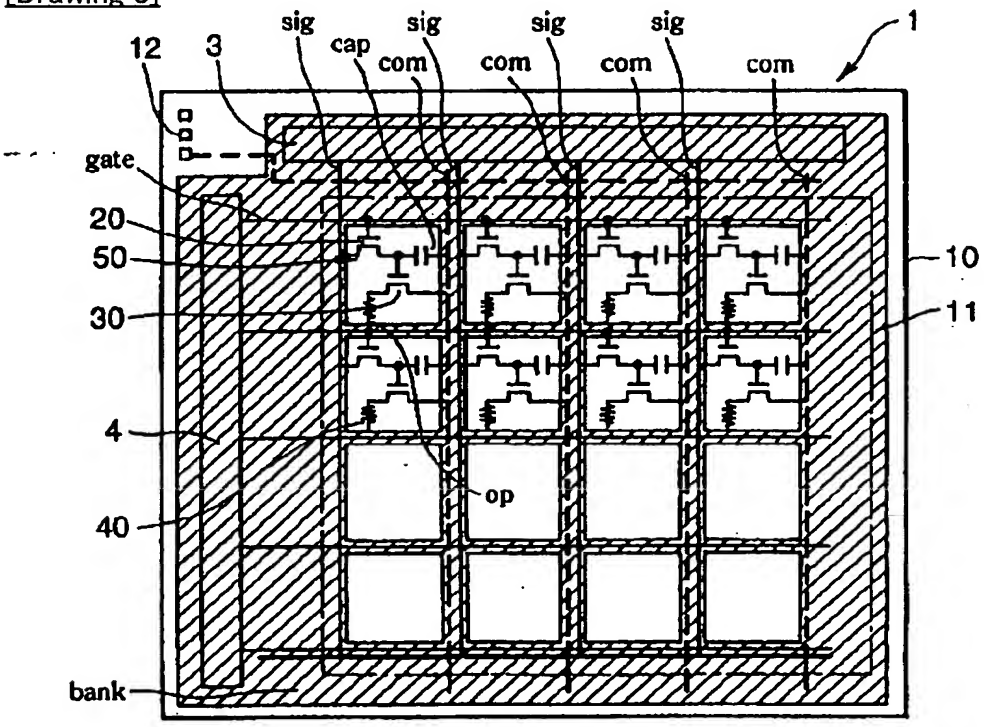
[Drawing 1]



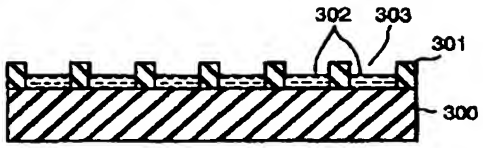
[Drawing 2]



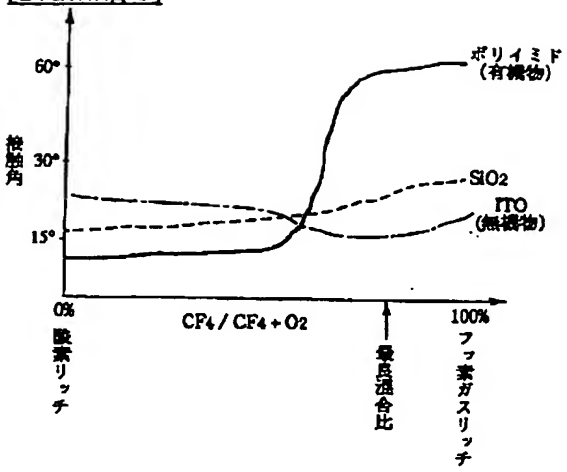
[Drawing 3]



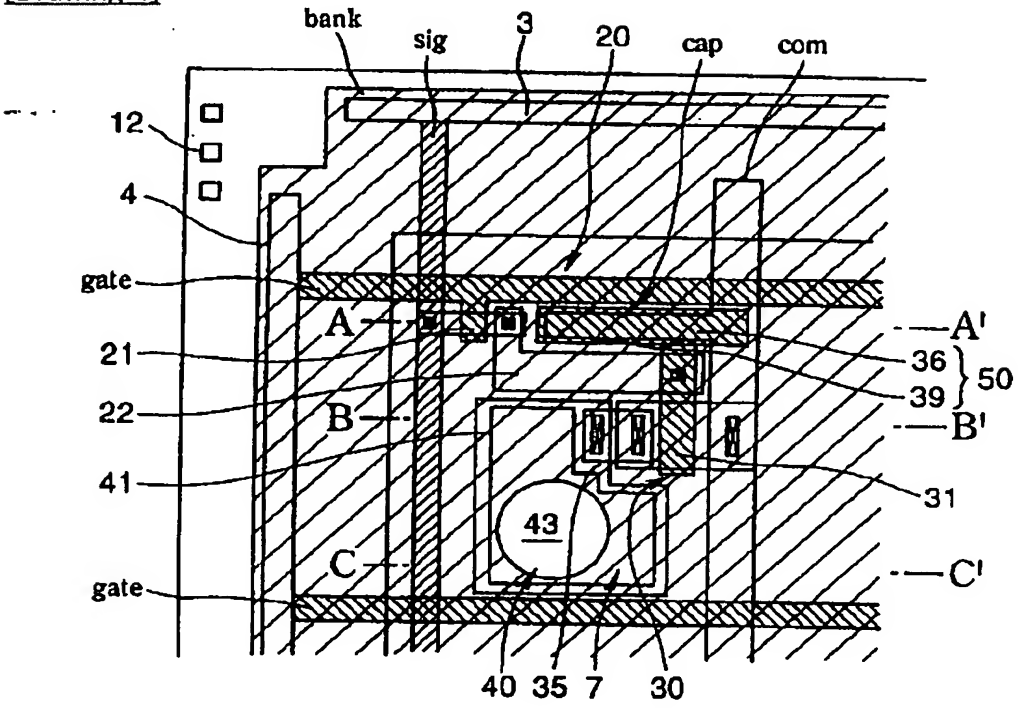
[Drawing 6]



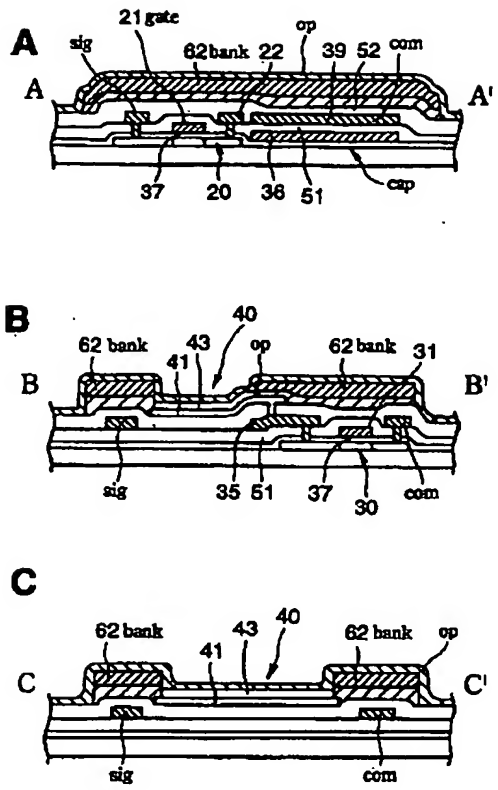
[Drawing 9]



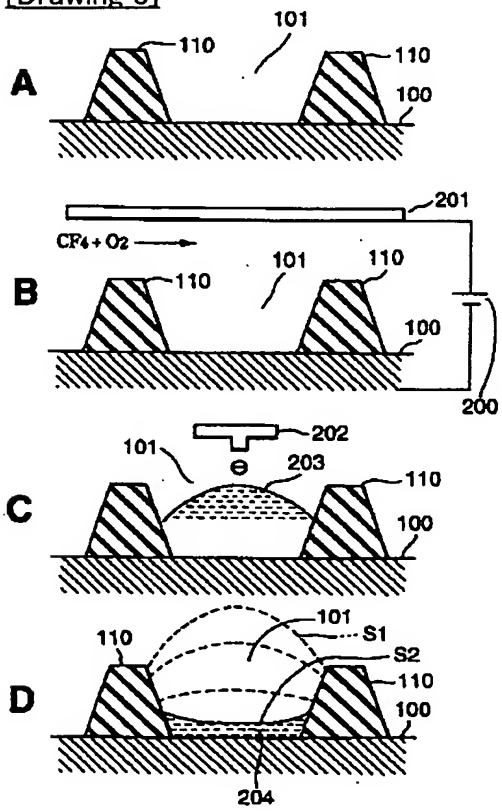
[Drawing 4]



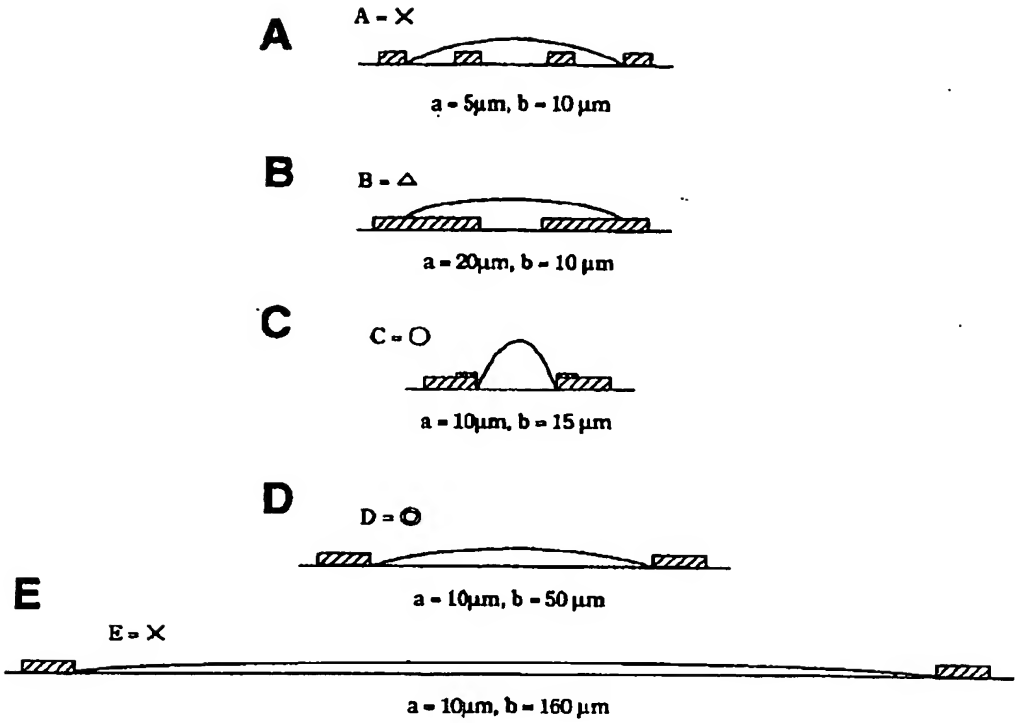
[Drawing 5]



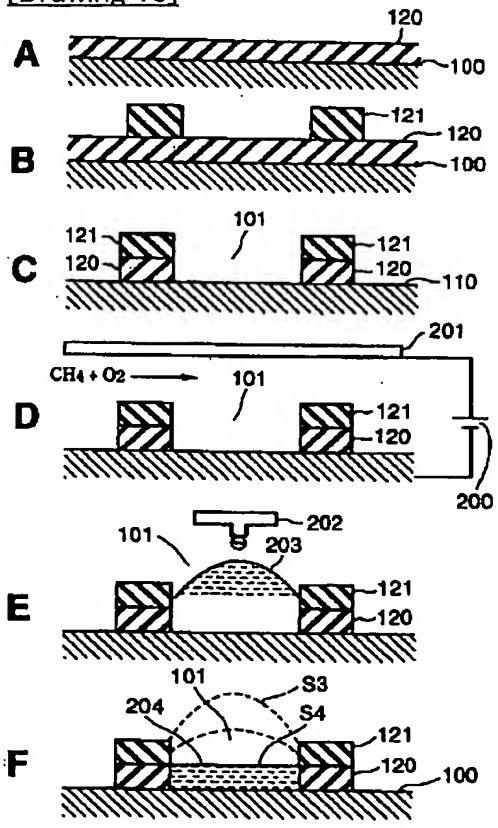
[Drawing 8]



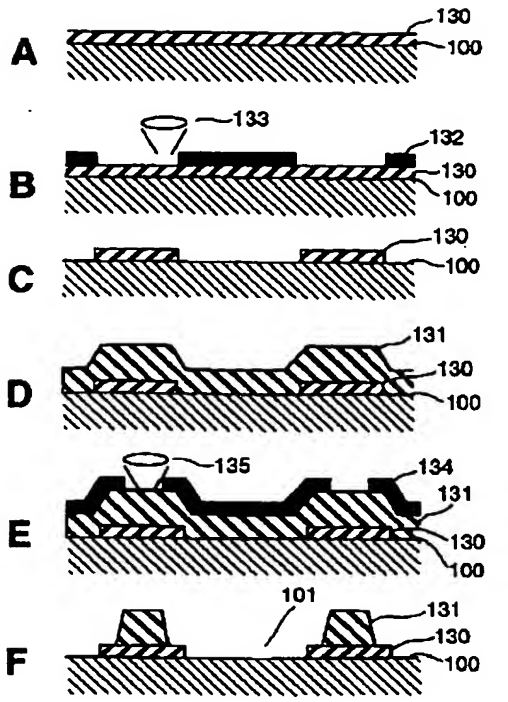
[Drawing 7]



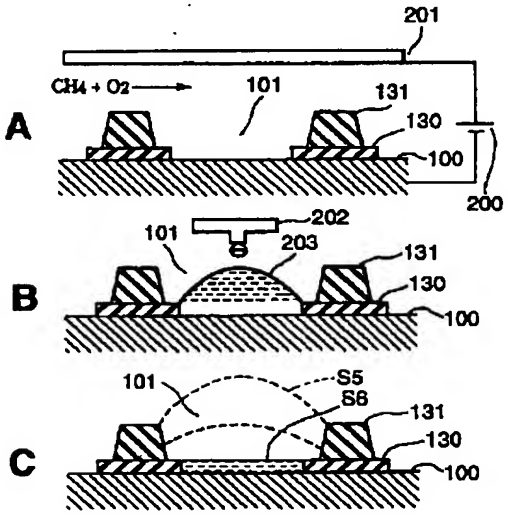
[Drawing 10]



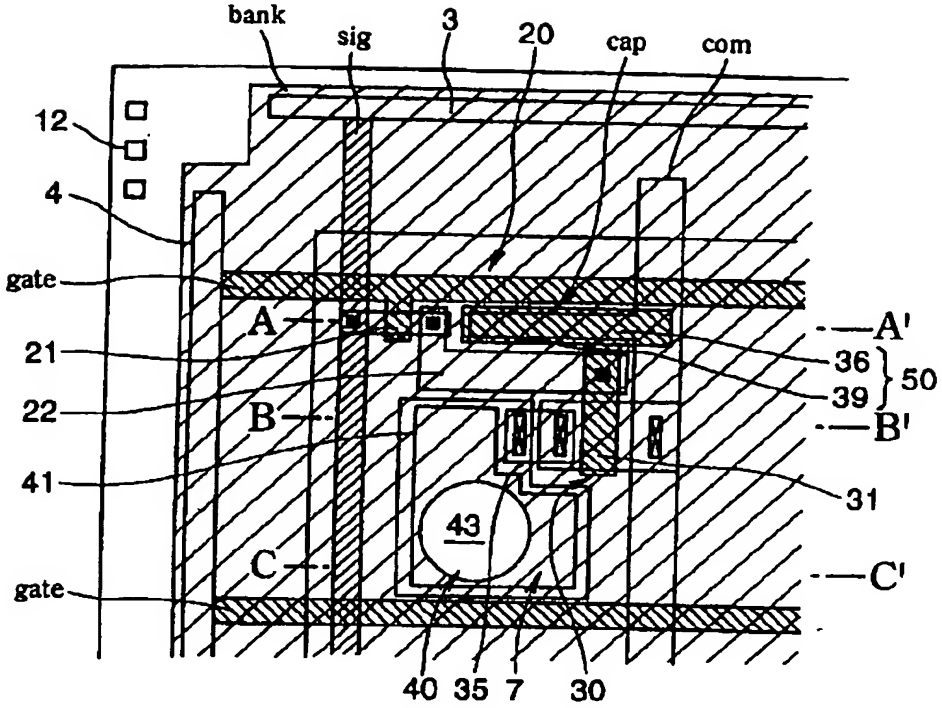
[Drawing 11]



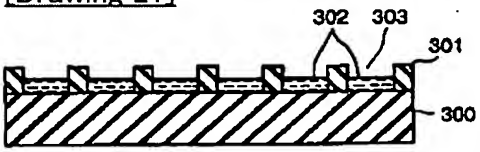
[Drawing 12]



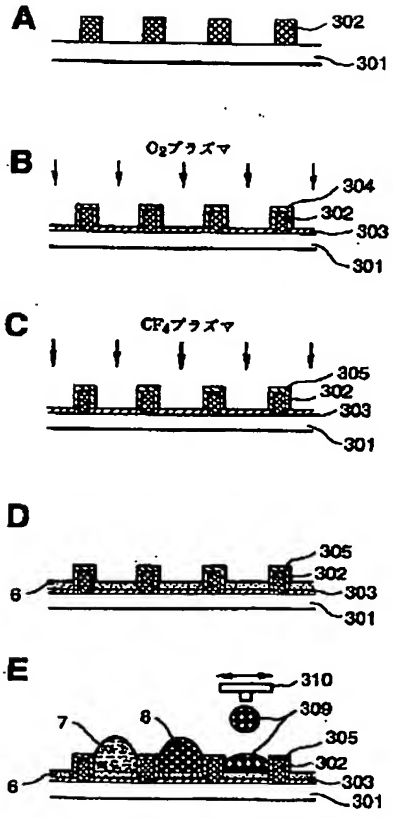
[Drawing 13]



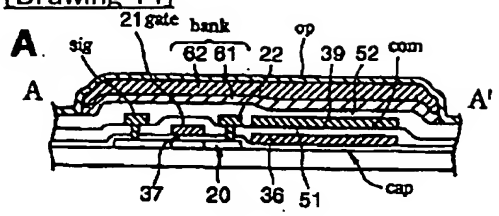
[Drawing 21]

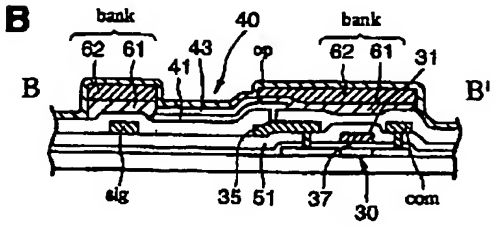


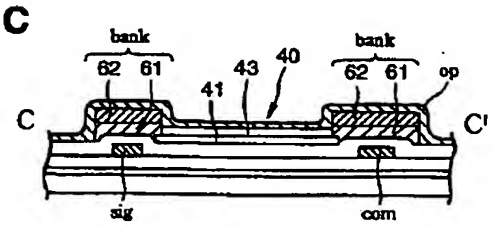
[Drawing 23]



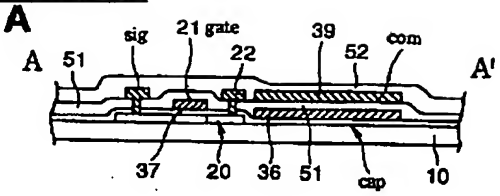
[Drawing 14]

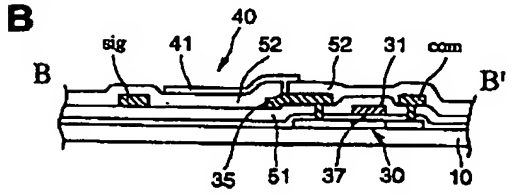


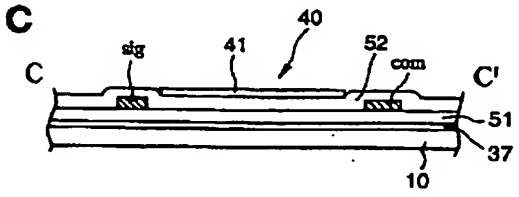




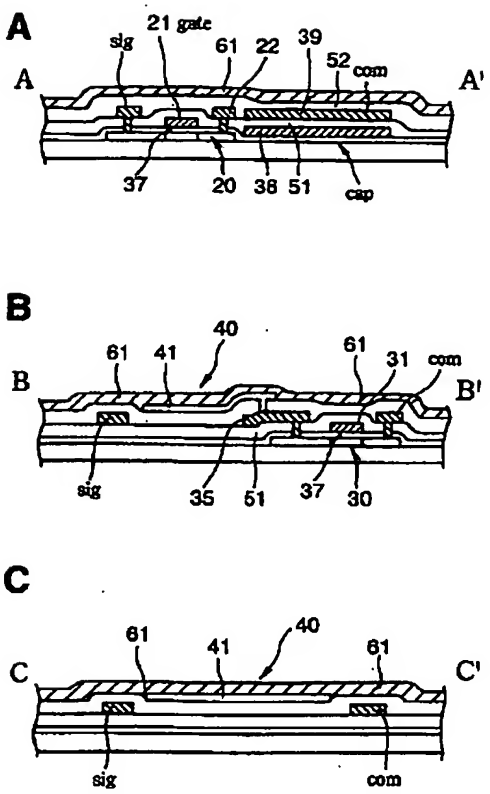
[Drawing 15]



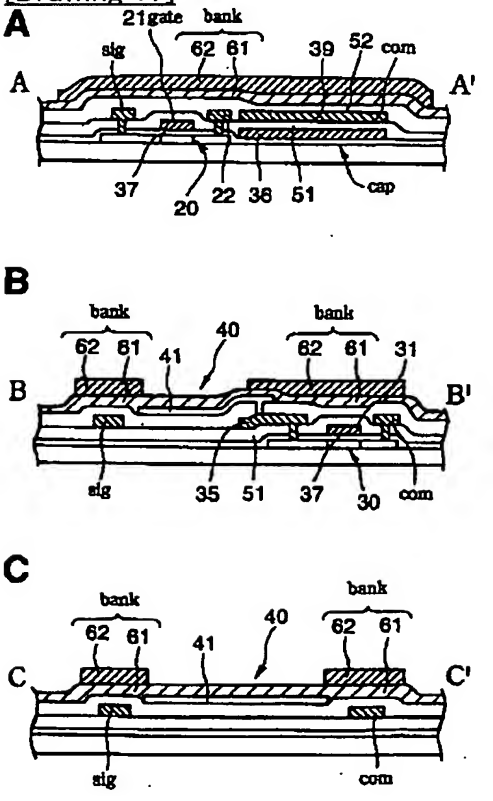




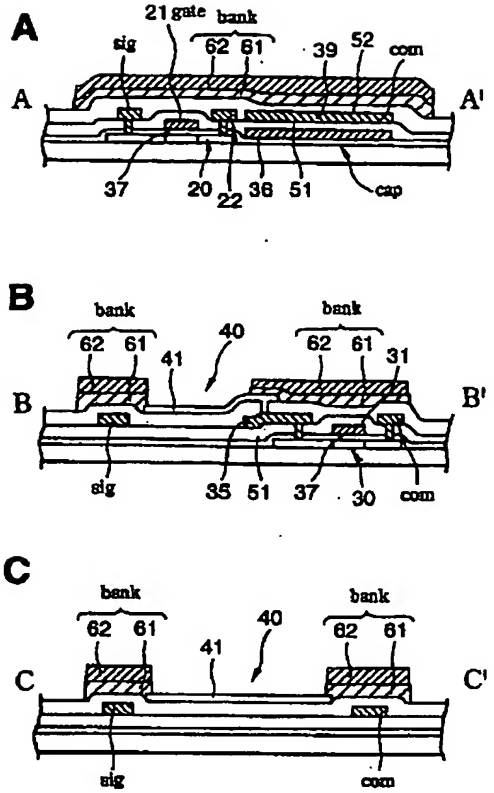
[Drawing 16]



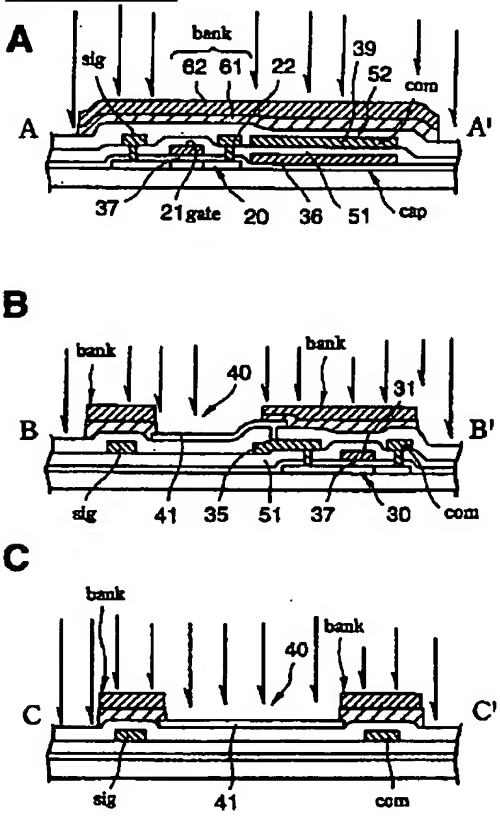
[Drawing 17]



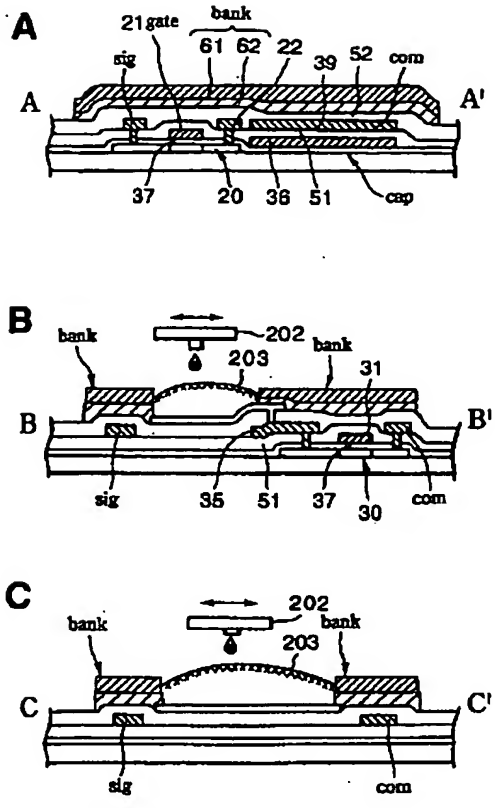
[Drawing 18]



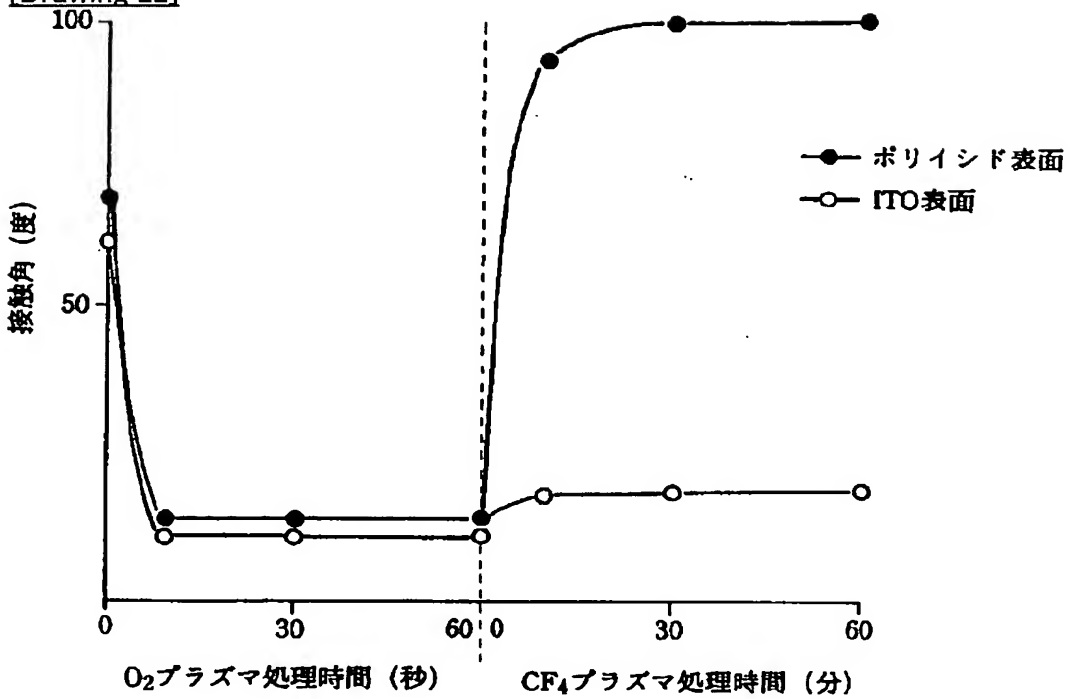
[Drawing 19]



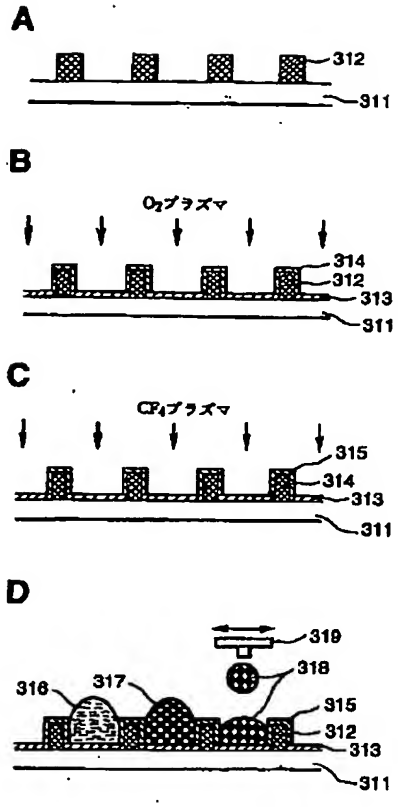
[Drawing 20]



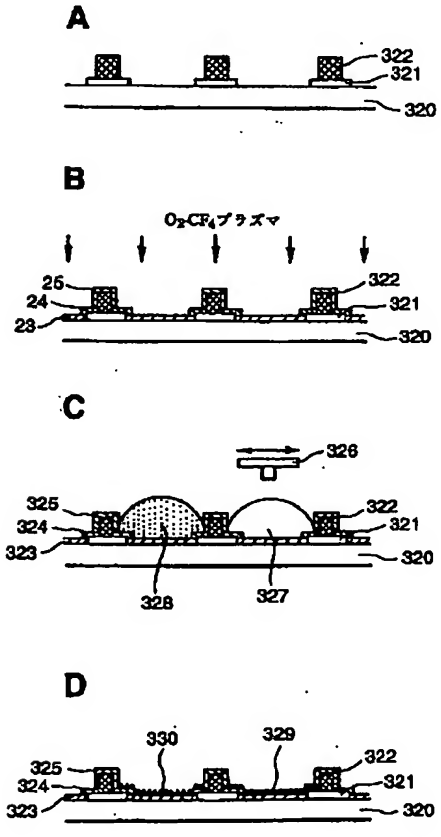
[Drawing 22]



[Drawing 24]

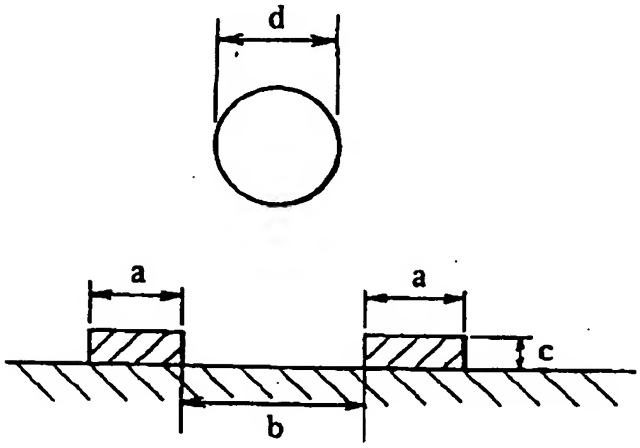

A
312
311
B
O2プラズマ
314
312
313
311
C
CF4プラズマ
315
314
313
311
D
319
318
316
317
315
312
313
311

[Drawing 25]


A
322
321
320
B
O2CF4プラズマ
25
24
23
322
321
320
C
326
325
324
323
322
321
320
328
327
D
330
329
325
324
323
322
321
320

[Translation done.]

Drawing selection [Representative drawing]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2000－353594
（P2000－353594A）
(43)公開日　平成12年12月19日(2000.12.19)

(51)Int.Cl.'	識別記号	FI		テーマコード'(参考)
H05B 33/22		H05B 33/22	Z	
G02B 5/20	101	G02B 5/20	101	
G09F 9/00	338	G09F 9/00	338	
9/30	310	9/30	310	
	365		365Z	

審査請求 未請求　請求項の数80　ＯＬ　（全 33 頁）　最終頁に続く

(21)出願番号　特願2000－76979(P2000－76979)
(62)分割の表示　特平11－546858の分割
(22)出願日　平成11年3月17日(1999.3.17)

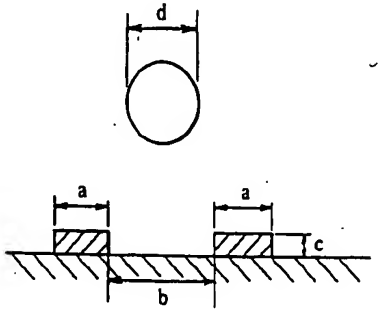
(31)優先権主張番号　特願平10－67503
(32)優先日　平成10年3月17日(1998.3.17)
(33)優先権主張国　日本（ＪＰ）
(31)優先権主張番号　特願平11－32123
(32)優先日　平成11年2月10日(1999.2.10)
(33)優先権主張国　日本（ＪＰ）

(71)出願人　000002369
セイコーエプソン株式会社
東京都新宿区西新宿２丁目４番１号
(72)発明者　岡　俊一
長野県諏訪市大和三丁目３番５号　セイコーエプソン株式会社内
(72)発明者　木口　浩史
長野県諏訪市大和三丁目３番５号　セイコーエプソン株式会社内
(74)代理人　100079108
弁理士　稲葉　良幸　（外２名）

最終頁に続く

(54)【発明の名称】　薄膜パターニング用基板

(57)【要約】　（修正有）
【課題】　有機半導体膜や発色樹脂等の薄膜を形成する際、画素毎での膜厚のばらつきが著しく少ないＥＬ素子やＬＥＤ素子などの表示装置あるいはカラーフィルタなどを提供する。
【解決手段】　基板上に、所定高さのバンクにより区切られた被塗布領域にインクジェット法により形成された薄膜層を有する薄膜素子において、バンクの幅をａ、高さをｃ、被塗布領域の幅をｂ、薄膜層を形成する液体材料の液滴径をｄとするとき、バンクを、ａ＞ｄ／４、ｄ／２＜ｂ＜５ｄ、ｃ＞t_0（t_0）は薄膜層の膜厚、ｃ＞ｄ／（２ｂ）の条件を満足するように基板上に形成する。また、無機材料で構成されるバンク形成面に有機材料でバンクを形成し、導入ガスをフッ素系としフッ素過多の条件下でプラズマ処理を行い、バンクで囲まれる領域に薄膜材料液を充填して薄膜層を形成する。さらに、有機物で形成したバンクを有する基板に、酸素ガスプラズマ処理後、フッ素系ガスプラズマ処理を行う。



1

【特許請求の範囲】
【請求項１】　インクジェット法により薄膜をパターニング形成するために用いられる、所定の高さのバンクおよび該バンクにより区切られた被塗布領域が面上に形成された薄膜パターニング用基板において、
前記バンクの幅をａ（μｍ）、その高さをｃ（μｍ）とし、前記被塗布領域の幅をｂ（μｍ）とし、かつ、薄膜層を形成する液体材料のインクジェット液滴径をｄ（μｍ）とするとき、前記バンクが、（ｄ／２）＜ｂ＜５ｄを満足するように形成されていることを特徴とする薄膜パターニング用基板。
【請求項２】　前記バンクが、更にａ＞（ｄ／４）を満足するように形成されていることを請求項１記載の薄膜パターニング用基板。
【請求項３】　前記バンクが、更にｃ＞t_0（t_0（μｍ）は薄膜層の膜厚）を満足するように形成されていることを特徴とする請求項１又は２記載の薄膜パターニング用基板。
【請求項４】　前記バンクが、更にｃ＞ｄ／（２ｂ）を満足するように形成されていることを特徴とする請求項１乃至３のいずれか一項記載の薄膜パターニング用基板。
【請求項５】　前記バンクの少なくとも上面が有機物で形成されていることを特徴とする請求項１乃至４のいずれか一項記載の薄膜パターニング用基板。
【請求項６】　前記バンクの上面および側面が有機物で形成されていることを特徴とする請求項１乃至４のいずれか一項記載の薄膜パターニング用基板。
【請求項７】　前記バンクは下層の無機物と上層の有機物との２層で形成されていることを特徴とする請求項１乃至４のいずれか一項記載の薄膜パターニング用基板。
【請求項８】　前記バンクは下層の無機物と上層の有機物との２層で形成され、該無機物の少なくとも側面は該有機物で覆っていないことを特徴とする請求項７記載の薄膜パターニング用基板。
【請求項９】　前記被塗布領域が無機物であることを特徴とする請求項１乃至８のいずれか一項記載の薄膜パターニング用基板。
【請求項１０】　前記バンクの上部上面に液滴溜構造を有する請求項１乃至９のいずれか一項記載の薄膜パターニング用基板。
【請求項１１】　前記バンクを形成する有機物表面の接触角が５０°以上、該バンクを形成する無機物表面に対する接触角が２０°～５０°、かつ前記薄膜液体材料に対する前記被塗布領域の表面の接触角が３０°以下になるように表面処理を施した請求項５乃至１０のいずれか一項記載の薄膜パターニング用基板。
【請求項１２】　前記表面改質がプラズマ処理によって行われることを特徴とする請求項１１記載の薄膜パターニング用基板。

2

【請求項１３】　請求項１乃至１２のいずれか一項に記載の薄膜パターニング用基板を用いてインクジェット法により薄膜をパターニング形成する薄膜形成方法。
【請求項１４】　請求項１３に記載の薄膜形成方法により形成される薄膜素子。
【請求項１５】　赤色、緑色または青色から選択された発光色を有する有機薄膜が独立してパターニングされた有機ＥＬ素子である請求項１４記載の薄膜素子。
【請求項１６】　赤色、緑色または青色から選択された発光色だけを透過する有機薄膜が独立してパターニングされたカラーフィルタである請求項１４記載の薄膜素子。
【請求項１７】　請求項１４乃至１６のいずれか一項記載の薄膜素子を備える表示装置。
【請求項１８】　請求項１７記載の表示装置と、この表示装置に対する回路装置とを備えてなる表示用電子機器。
【請求項１９】　ディップ法またはスピンコート法により薄膜をパターニング形成するために用いられる、所定の高さのバンクおよび該バンクにより区切られた被塗布領域が面上に形成された薄膜パターニング用基板において、
少なくとも該バンクの表面が有機物で形成され、前記被塗布領域が無機物で形成されていることを特徴とする薄膜パターニング用基板。
【請求項２０】　ディップ法またはスピンコート法により薄膜をパターニング形成するために用いられる、所定の高さのバンクおよび該バンクにより区切られた被塗布領域が面上に形成された薄膜パターニング用基板において、
前記バンクの上面および側面が有機物で形成され、前記被塗布領域が無機物で形成されていることを特徴とする薄膜パターニング用基板。
【請求項２１】　ディップ法またはスピンコート法により薄膜をパターニング形成するために用いられる、所定の高さのバンクおよび該バンクにより区切られた被塗布領域が面上に形成された薄膜パターニング用基板において、
前記バンクは下層の無機物と上層の有機物との２層で形成され、前記被塗布領域が無機物で形成されていることを特徴とする薄膜パターニング用基板。
【請求項２２】　前記バンクにおける下層の無機物の少なくとも側面は前記有機物で覆っていないことを特徴とする請求項２１記載の薄膜パターニング用基板。
【請求項２３】　前記バンクを形成する有機物表面の接触角が５０°以上、該バンクを形成する無機物表面に対する接触角が２０°～５０°、かつ前記薄膜液体材料に対する前記被塗布領域の表面の接触角が３０°以下になるように表面処理を施した請求項１９乃至２２のいずれか一項記載の薄膜パターニング用基板。

【請求項２４】　前記表面処理がプラズマ処理によって行われることを特徴とする請求項２３記載の薄膜パターニング用基板。

【請求項２５】　請求項１９乃至２４のいずれか一項に記載の薄膜パターニング用基板を用いてディップ法またはスピンコート法により薄膜をパターニング形成する薄膜形成方法。

【請求項２６】　前記ディップ法またはスピンコート法に用いる液体材料の表面張力が３０ｄｙｎｅ／ｃｍ以下の値である請求項２５記載の薄膜形成方法。

【請求項２７】　請求項２５または２６に記載の薄膜形成方法により形成される薄膜素子。

【請求項２８】　請求項２７記載の薄膜素子を備えてなる表示装置。

【請求項２９】　請求項２８記載の表示装置と、この表示装置に対する電子回路とを備えてなる表示用電子機器。

【請求項３０】　バンクで囲まれた領域に薄膜材料液を充填して薄膜層を形成する薄膜形成方法であって、
無機材料で構成されるバンク形成面に有機材料で前記バンクを形成するバンク形成工程と、
所定の表面処理を行った場合に、前記有機材料が前記無機材料に比べて前記薄膜材料液に対する非親和性の程度がより高くなるような一定条件下で前記バンクおよび前記バンク形成面に対して前記表面処理を施す表面処理工程と、
前記表面処理がされたバンクで囲まれる領域に前記薄膜材料液を充填して薄膜層を形成する薄膜層形成工程と、
を備えたことを特徴とする薄膜形成方法。

【請求項３１】　前記表面処理は、導入ガスにフッ素またはフッ素化合物を含んだガスを使用し、減圧雰囲気下でプラズマ照射をする減圧プラズマ処理である請求項３０に記載の薄膜形成方法。

【請求項３２】　前記表面処理は、導入ガスにフッ素またはフッ素化合物を含んだガスを使用し、大気圧雰囲気下でプラズマ照射をする大気圧プラズマ処理である請求項３０に記載の薄膜形成方法。

【請求項３３】　前記一定条件は、フッ素系化合物が酸素よりも多いことを条件とする請求項３１または請求項３２に記載の薄膜形成方法。

【請求項３４】　前記一定条件は、フッ素系化合物および酸素の総量に対するフッ素系化合物の含有量が６０％以上に設定されている請求項３３に記載の薄膜形成方法。

【請求項３５】　前記フッ素またはフッ素化合物を含んだガスはCF_4、SF_6、CHF_3等のハロゲンガスを用いる請求項３１または３２に記載の薄膜形成方法。

【請求項３６】　前記薄膜材料液の前記バンク形成面に対する接触角が２０度以下になるように前記表面処理の条件が設定される請求項３０に記載の薄膜形成方法。

【請求項３７】　前記薄膜材料液の前記バンク形成面に対する接触角が５０度以上になるように前記表面処理の条件が設定される請求項３０に記載の薄膜形成方法。

【請求項３８】　前記バンク形成工程は、前記バンクを上層および下層の二層で形成する請求項３０に記載の薄膜形成方法。

【請求項３９】　前記バンク形成工程は、前記バンク形成面に下層膜を形成する下層膜形成工程と、前記下層膜上で前記バンクの形成領域に合わせて上層を形成する上層形成工程と、前記上層をマスクとして当該上層が設けられていない領域の前記下層膜をエッチングして除去する除去工程と、を備える請求項３８に記載の薄膜形成方法。

【請求項４０】　前記バンク形成工程は、前記バンク形成面に下層膜を形成する下層膜形成工程と、当該下層膜を前記バンク下層の形成領域に合わせて露光・現像する工程と、前記下層を覆って上層膜を形成する上層膜形成工程と、当該上層膜を前記バンク上層の形成領域に合わせて露光・現像する工程と、を備える請求項３８に記載の薄膜形成方法。

【請求項４１】　前記表面処理は、前記バンク下層の前記薄膜材料液に対する親和性が前記画素電極のそれ以下であって前記バンク上層のそれ以上に設定するものである請求項３８に記載の薄膜形成方法。

【請求項４２】　前記バンク上層の表面が前記薄膜材料液に対し接触角が５０度以上になるように前記表面処理の条件が設定される請求項３８に記載の薄膜形成方法。

【請求項４３】　前記バンク下層の表面が前記薄膜材料液に対し接触角が２０度乃至４０度の範囲になるように前記表面処理の条件が設定される請求項３８に記載の薄膜形成方法。

【請求項４４】　前記バンクで囲まれる領域には画素電極が設けられ、前記薄膜材料液は薄膜発光素子を形成するための有機半導体材料である請求項３０乃至請求項４３に記載の薄膜形成方法。

【請求項４５】　前記画素電極はＩＴＯ電極膜である請求項４４に記載の薄膜形成方法。

【請求項４６】　前記バンクは絶縁有機材料である請求項３０に記載の薄膜形成方法。

【請求項４７】　前記バンク下層はシリコン酸化膜、シリコン窒化膜またはアモルファスシリコンのいずれかである請求項３８に記載の薄膜形成方法。

【請求項４８】　請求項３０乃至請求項４７のいずれか一項に記載された薄膜形成方法で製造された表示装置。

【請求項４９】　基板上に形成されたバンクで囲まれた領域に薄膜材料液を充填するための基板の表面改質方法であって、バンクが形成された基板に、酸素ガスプラズマ処理を行う第一工程と、前記第一工程後、これに続けてフッ素系ガスプラズマ処理を行う第二工程とを備えた表面改質方法。

【請求項５０】　少なくとも前記第一工程および第二工程のいずれかのプラズマ処理が、大気圧下で処理される大気圧プラズマであることを特徴とする請求項４９記載の表面改質方法。

【請求項５１】　少なくとも前記第一工程および第二工程のいずれかのプラズマ処理が、減圧下で処理される減圧プラズマであることを特徴とする請求項４９記載の表面改質方法。

【請求項５２】　基板上に形成されたバンクで囲まれた領域に薄膜材料液を充填するための表面改質方法であって、バンクが形成された基板に、フッ素系ガスプラズマ処理を行う工程を備えた表面改質方法。

【請求項５３】　前記プラズマ処理が、減圧下で処理される減圧プラズマであることを特徴とする請求項５２記載の表面改質方法。

【請求項５４】　前記基板が無機物であることを特徴とする請求項４９乃至５３のいずれか一項に記載の表面改質方法。

【請求項５５】　前記基板上に形成されたバンクにおいて、少なくとも該バンクの上面が有機物で形成されていることを特徴とする請求項４９乃至５３のいずれか一項に記載の表面改質方法。

【請求項５６】　前記基板上に形成されたバンクにおいて、該バンクの上面および側面が有機物で形成されていることを特徴とする請求項４９乃至５３のいずれか一項に記載の表面改質方法。

【請求項５７】　前記基板上に形成されたバンクにおいて、該バンクは下層の無機物と上層の有機物の２層で形成されていることを特徴とする請求項４９乃至５３のいずれか一項に記載の表面改質方法。

【請求項５８】　前記基板上に形成されたバンクにおいて、該バンクは下層の無機物と上層の有機物の２層で形成され、該無機物の少なくとも側面は該有機物で覆われていないことを特徴とする請求項４９乃至５３のいずれか一項に記載の表面改質方法。

【請求項５９】　前記無機物からなる基板表面を前記薄膜材料液に対して親液化する請求項５４記載の表面改質方法。

【請求項６０】　前記バンクを形成する有機物表面を前記薄膜材料液に対して撥液化する請求項５５乃至５８のいずれか一項に記載の表面改質方法。

【請求項６１】　前記バンクを形成する有機物表面をテフロン（登録商標）化する請求項６０記載の表面改質方法。

【請求項６２】　前記バンクを形成する有機物表面を前記薄膜材料液に対して撥液化し、かつ前記無機物からなる基板表面を前記薄膜材料液に対して親液化する請求項４９乃至６１のいずれか一項に記載の表面改質方法。

【請求項６３】　前記薄膜材料液の前記基板表面に対する接触角が、３０度以下である請求項５９に記載の表面改質方法。

【請求項６４】　前記薄膜材料液の前記バンクを形成する有機物表面に対する接触角が、５０度以上である請求項６０に記載の表面改質方法。

【請求項６５】　前記薄膜材料液の前記基板表面に対する接触角が、３０度以下であり、かつ前記バンクを形成する有機物表面に対する接触角が、５０度以上である請求項６２に記載の表面改質方法。

【請求項６６】　前記薄膜材料液の前記基板表面に対する接触角が、３０度以下、前記バンクを形成する下層表面に対する接触角が、２０度から５０度、前記バンク上層を形成する有機物表面に対する接触角が、５０度以上である請求項４９乃至６５のいずれか一項に記載の表面改質方法。

【請求項６７】　基板上に形成されたバンクで囲まれた領域に薄膜材料液を充填し、薄膜を形成する方法であって、請求項４９乃至６６のいずれか一項に記載の表面改質方法が施された基板のバンクで囲まれた領域に、当該表面改質後直ちにインクジェット方式によって前記薄膜材料液を充填する工程を備えた薄膜形成方法。

【請求項６８】　基板上に形成されたバンクで囲まれた領域に薄膜材料液を充填し、薄膜を形成する方法であって、請求項４９乃至６６のいずれか一項に記載の表面改質方法が施された基板のバンクで囲まれた領域に、当該表面改質後直ちにスピンコート法あるいはディップ法等によって前記薄膜材料液を充填する工程を備えた薄膜形成方法。

【請求項６９】　請求項６７または６８に記載の薄膜形成方法により形成した薄膜を備えた薄膜素子。

【請求項７０】　請求項６７または６８に記載の薄膜形成方法により形成した薄膜を有する構造をカラーフィルターとして備えた表示装置。

【請求項７１】　請求項６７または６８に記載の薄膜形成方法により形成した薄膜を有する構造を有機ＥＬ素子として備えた表示装置。

【請求項７２】　請求項６７または６８に記載の薄膜形成方法により薄膜を形成する薄膜素子の製造方法。

【請求項７３】　請求項６７または６８に記載の薄膜形成方法により薄膜を形成し、これをカラーフィルターとする請求項６９記載の薄膜素子の製造方法。

【請求項７４】　前記薄膜素子が有機ＥＬ素子である請求項７２記載の薄膜素子の製造方法。

【請求項７５】　前記バンクで囲まれた部分の平面形状が円形又は楕円形である請求項１記載の薄膜パターニング用基板。

【請求項７６】　基板と、この基板上に所定のパターンの形状のバンクを有する薄膜パターニング用基板において、該バンクにより形成された開口部の形状が網状である薄膜パターニング基板。

【請求項７７】　前記網状の開口部の形状が円形又は楕

7

円形である請求項７６記載のパターニング用基板。

【請求項７８】　基板と、該基板上に所定のパターンの形状のバンクと、該バンクに囲まれた領域に発光材料薄膜を有するＥＬ素子において、該バンクにより形成された開口部の形状が環状であるＥＬ素子。

【請求項７９】　前記環状の開口部の形状が円形又は楕円形である請求項７８記載のＥＬ素子。

【請求項８０】　基板上に設けられたバンクで囲まれた領域に薄膜形成材料を充填するための基板の表面改質方法であって、バンクが形成された基板全表面に一連の表面改質処理を均一に行い、この一連の処理によりバンク部表面の薄膜形成材料に対する非親和性を、バンク間部分の表面のそれに対して高める工程を有する基板の表面改質方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】薄膜パターニング用基板およびその表面処理

本発明は、有機半導体膜を用いたＥＬ（エレクトロルミネッセンス）素子やＬＥＤ（発光ダイオード）素子などの表示装置あるいはカラーフィルタの製造に適した薄膜形成技術に係わる。

【０００２】特に、フルカラー有機ＥＬ（エレクトロルミネッセンス）素子、カラーフィルタなど、特性の異なる薄膜を同一基板上にパターニング成膜するための基板、薄膜形成方法、および薄膜素子に関する。また、インクジェット方式によって薄膜層を形成しやすく、かつ平坦な薄膜層が形成可能で、微細パターニングを必要とする薄膜形成方法に関する。さらに、基板上に形成したバンクで囲まれた領域に薄膜材料液をインクジェット法あるいはスピンコート等で高精細にパターニング充填するための表面改質方法、及びこの表面改質方法を利用して薄膜を形成する方法、並びにこの薄膜を備えた表示装置およびその製造方法に関する。

【０００３】

【従来の技術及び発明が解決しようとする課題】近年、同一基板に特性の異なる薄膜を塗布により所定のパターンで形成して、機能素子を得ようとする技術が開発されている。その有力な方法としてインクジェット方式により、同一基板上に異なる薄膜パターンの形成がなされている。しかしながら、インクジェット方式を用いる場合では、基板上で異なる薄膜材料が混合するといったプロセス面での問題が生じる。具体的には、インクジェット方式を利用してＥＬ素子などの表示装置における有機半導体材料やカラーフィルタにおける着色樹脂等の薄膜材料を塗設する技術が用いられているが、インクジェット方式を利用して液体材料を充填し薄膜のパターンを形成する場合、吐出された液体材料が隣接する画素に流出する等の問題が生じている。

【０００４】このような問題に対して、通常、異なる薄膜領域を仕切る凸状の仕切部材（「バンク」または「凸部」とも呼ばれる）を設け、該仕切部材で囲まれた領域に異なる薄膜となる液体材料を充填する方法が採られている。上記表示素子の例では、各色発領域を仕切る仕切部材を設け、各仕切領域で囲まれた領域に画素を構成する材料を充填する方法が採られる。

【０００５】最近の機能素子、特に表示装置では一般に薄さが要求され、仕切部材の高さがそれに従い制限されるにもかかわらず、仕切部材で囲まれる領域には、製膜後の体積に比較してはるかに大量の液体材料が充填されている。

【０００６】このため、仕切部材に囲まれた領域に吐出される液滴の大きさと仕切部材表面やこれに囲まれる領域の面積とのバランスのまずさから問題が生じる。この問題を以下に説明する。

【０００７】仕切部材が、充填すべき薄膜材料である液体材料に対して親液性、或いは濡れ性を有すると場合、仕切り部材があっても仕切り部材に引っ張られ、最終的な薄膜では所望の膜厚を得ることができず、また、液体材料の量を多くすれば、液体材料は容易に隣接する領域に流出してしまう。

【０００８】一方、仕切り部材で囲まれた領域の表面は、液体材料がこれに均一に濡れ拡がるように、液体材料に対して高い親和性、濡れ性を有する必要がある。さもなくば、液体材料が仕切部材で囲まれた領域に濡れ拡がらず、特にＥＬ素子のような表示素子では画素における色抜けや色むらが生じてしまう。

【０００９】このような問題に対して、例えば、特開平９－２０３８０３号公報、特開平９－２３０１２９号公報には、仕切部材の上部を撥液性にし、それ以外の部分が親液性となるように表面処理をする技術が提案されている。

【００１０】これらの従来例はともに、仕切部材の上面に撥液性の材料からなる層（フッ素化合物からなる層）を形成するもので、特開平９－２０３８０３号公報には、非親和性を示す層を仕切部材の上部に塗布し、仕切部材で囲まれた領域の表面を親水性基界面活性剤で処理する技術が記載されており、特開平９－２３０１２９号公報には、更に紫外線照射により仕切部材で囲まれた凹部を親和性にする技術が記載されている。その論理的考察については、International Display Research Conference 1997, pp238-241に記載されている。

【００１１】しかしながら、前記従来技術におけるように、仕切部材上面の撥液性及び仕切部材で囲まれる領域の親液性がある程度実現されたとしても、例えば、インクジェット方式を用いて液体材料を塗布する場合は、吐出される液滴の大きさと、上記仕切部材表面やこれに囲まれる領域の面積に対して極端に大きいあるいは小さいなど、これらのバランスが著しく悪い場合は、液体材料が被塗布領域に正確に充填されず、精度の高いパターニングが不可能となることがわかった。例えば、上記液滴の大きさが仕切部材に囲まれる領域よりも大きく成り過ぎると液滴が仕切部材上に乗り上げ、更に仕切部材上部表面が狭い場合は液滴が目的とする被塗布領域に隣接する領域に溢れ出てしまう。

9

【００１２】このように、液滴の大きさと、仕切部材やこれに囲まれる領域の面積との関係が適性でない場合は、上記のような問題に起因して仕切部材で囲まれた領域間での薄膜材料液の混合や形成する薄膜毎に膜厚のばらつきを生じることとなる。

【００１３】また、仕切部材で区画された領域に薄膜材料を充填する際には仕切り部材の薄膜材料液に対する親和性に関して更に問題も生じる。

【００１４】仕切部材や仕切部材で囲まれた領域が、薄膜材料液に対してどのような濡れ性（親和性）を示すかで充填された薄膜材料液の挙動が異なる。既述したように、仕切部材の表面が薄膜材料液に対し親和性（親水性）を示すと、仕切部材の高さを超える量の材料を充填した場合に、仕切部材があっても薄膜材料液は容易に隣接する仕切部材で囲まれた領域に流出してしまう。逆に仕切部材の表面が薄膜材料液に対し適度に非親和性（撥水性）を示すと、仕切部材の高さを超える量の材料を充填しても材料の表面張力により隣の仕切部材で囲まれた領域に薄膜材料液が流れ出すことはない。

【００１５】そしてより具体的な基板表面の改質法として特定の性質を得るため当該表面のカラーフィルターの製造、例えば、既述した特開平９－２０３８０３号公報、特開平９－２３０１２９号公報、更には特開平９－２３０１２７号公報に記載されているもの、すなわち、バンク表面をフッ素系化合物で撥インク処理する方法であって、バンクで囲まれる領域を親水性基を有する界面活性剤等で処理する技術（特開平９－２０３８０３号公報）、エッチングにより処理する方法（特開平９－２３０１２７号公報）、あるいはエネルギー照射（特開平９－２３０１２９号公報）により親インク処理があげられる。

【００１６】しかしながら、特に、フッ素系化合物材料を用いて部材表面を撥インク性にする場合、あるいはフッ素系化合物材料を用いて部材を形成する場合、前記フッ素系材料と部材を形成する下地層あるいは下地基板との密着性が悪くなり基板上にバンクを形成する技術へ応用を考えると問題がある。また、部材、特にバンク自体を撥インク性のフッ素系化合物材料等で形成できたとしてもフォトリソグラフィーによるパターニング後、バンク領域に残さが生じバンク表面の親インク性が損なわれるおそれがある。

【００１７】また、上記公知技術では仕切部材上部を非親和性にするためだけに非親和性を示す材料の塗布、乾燥、除去等が必要となり、工程数が多くならざるを得なかった。また、紫外線照射を行う場合には多くの材料で

10

親和性となる傾向がある。材料が非親和性材料であっても紫外線照射により若干親和性を生ずるようになり、折角の非親和性処理が無駄になる傾向があった。特に、特開平９－２３０１２９号公報には紫外線を表裏の両面から照射することで親和性の程度を制御する旨が規定されているが、非親和性と親和性との親和性の制御、例えば薄膜材料液に対する接触角をそれぞれどのように設定するかについては不明であった。

【００１８】また、仕切部材の撥液性が強い場合、仕切部材の側壁で薄膜材料の液がはじかれるため、成膜後の厚みが仕切部材で囲まれた領域の中央部で厚く周辺部で薄くなる。これでは、表示素子に画素での色むらが生じる。特に、ＥＬ素子においてはショートが生じ易く信頼性の低下につながる。

【００１９】仕切部材の表面に撥液処理を施して、その側面に親和性（親液性）を付与した場合には、薄膜材料を提供して成膜後の厚みが仕切部材で囲まれた領域の周辺で薄くなることはないが、薄膜材料の液の大部分が仕切部材の側面に引っ張られるため、薄膜の堤部分、即ち、基板と接する部分で膜厚がより大きくなるだけではなく、膜厚の制御が困難となることもない。

【００２０】有機物質の表面エネルギー（濡れ性）の改質方法として、プラズマ処理を行うことはよく知られている。このような表面改質方法としては、例えば、特開昭６３－３０８９２０号公報に記載されているものがある。この公報に記載された表面改質方法は、フッ素系ガスと酸素ガスを含む混合ガスプラズマを用いて有機物質表面を処理し、前記混合ガスの混合比を変えることにより、前記有機物質の表面エネルギーを制御するものである。

【００２１】また、ガラスやＩＴＯ（Indium Tin Oxide）などの無機物表面を親水化するためにＵＶ照射や酸素プラズマ処理をする方法も良く知られた手法である。

【００２２】しかしながら、同一基板上に有機物或いは無機物からなる層のパターンを設ける場合、この基板においてプラズマ処理やＵＶ照射により各々の材料の濡れ性を簡便かつ厳密に制御する技術は報告されていない。混合ガスプラズマ処理により有機物質表面あるいは有機物で形成される部材表面に撥インク性を付与する方法では、効率よく撥インク性を付与することができなかったり、表面の撥インク性が一過性であり、熱工程を経たり、時間が経過すると撥インク性が劣化するという問題がある。

【００２３】また、エネルギー照射により、親インク処理を行う場合、バンク表面の撥インク性を損なうおそれがあり、バンク表面の撥インク性とバンク表面の親インク性を同時に達成することは困難である。

【００２４】このように異なる薄膜材料を供給し、所定のパターンの薄膜を形成する方法、特に基板上に形成された仕切部材（バンク）で囲まれた領域に薄膜材料液を

円形である請求項７６記載のパターニング用基板。

【請求項７８】　基板と、該基板上に所定のパターンの形状のバンクと、該バンクに囲まれた領域に発光材料薄膜を有するＥＬ素子において、該バンクにより形成された開口部の形状が環状であるＥＬ素子。

【請求項７９】　前記環状の開口部の形状が円形又は楕円形である請求項７８記載のＥＬ素子。

【請求項８０】　基板上に設けられたバンクで囲まれた領域に薄膜形成材料を充填するための基板の表面改質方法であって、バンクが形成された基板全表面に一連の表面改質処理を均一に行い、この一連の処理によりバンク部表面の薄膜形成材料に対する非親和性を、バンク間部分の表面のそれに対して高める工程を有する基板の表面改質方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】薄膜パターニング用基板およびその表面処理

本発明は、有機半導体膜を用いたＥＬ（エレクトロルミネッセンス）素子やＬＥＤ（発光ダイオード）素子などの表示装置あるいはカラーフィルタの製造に適した薄膜形成技術に係わる。

【０００２】特に、フルカラー有機ＥＬ（エレクトロルミネッセンス）素子、カラーフィルタなど、特性の異なる薄膜を同一基板上にパターニング成膜するための基板、薄膜形成方法、および薄膜素子に関する。また、インクジェット方式によって薄膜層を形成しやすく、かつ平坦な薄膜層が形成可能で、微細パターニングを必要とする薄膜形成方法に関する。さらに、基板上に形成したバンクで囲まれた領域に薄膜材料液をインクジェット法あるいはスピンコート等で高精細にパターニング充填するための表面改質方法、及びこの表面改質方法を利用して薄膜を形成する方法、並びにこの薄膜を備えた表示装置およびその製造方法に関する。

【０００３】

【従来の技術及び発明が解決しようとする課題】近年、同一基板に特性の異なる薄膜を塗布により所定のパターンで形成して、機能素子を得ようとする技術が開発されている。その有力な方法としてインクジェット方式により、同一基板上に異なる薄膜パターンの形成がなされている。しかしながら、インクジェット方式を用いる場合では、基板上で異なる薄膜材料が混合するといったプロセス面での問題が生じる。具体的には、インクジェット方式を利用してＥＬ素子などの表示装置における有機半導体材料やカラーフィルタにおける着色樹脂等の薄膜材料を塗設する技術が用いられているが、インクジェット方式を利用して液体材料を充填し薄膜のパターンを形成する場合、吐出された液体材料が隣接する画素に流出する等の問題が生じている。

【０００４】このような問題に対して、通常、異なる薄膜領域を仕切る凸状の仕切部材（「バンク」または「凸部」とも呼ばれる）を設け、該仕切部材で囲まれた領域に異なる薄膜となる液体材料を充填する方法が採られている。上記表示素子の例では、各色発領域を仕切る仕切部材を設け、各仕切領域で囲まれた領域に画素を構成する材料を充填する方法が採られる。

【０００５】最近の機能素子、特に表示装置では一般に薄さが要求され、仕切部材の高さがそれに従い制限されるにもかかわらず、仕切部材で囲まれる領域には、製膜後の体積に比較してはるかに大量の液体材料が充填されている。

【０００６】このため、仕切部材に囲まれた領域に吐出される液滴の大きさと仕切部材表面やこれに囲まれる領域の面積とのバランスのまずさから問題が生じる。この問題を以下に説明する。

【０００７】仕切部材が、充填すべき薄膜材料である液体材料に対して親液性、或いは濡れ性を有すると場合、仕切り部材があっても仕切り部材に引っ張られ、最終的な薄膜では所望の膜厚を得ることができず、また、液体材料の量を多くすれば、液体材料は容易に隣接する領域に流出してしまう。

【０００８】一方、仕切り部材で囲まれた領域の表面は、液体材料がこれに均一に濡れ拡がるように、液体材料に対して高い親和性、濡れ性を有する必要がある。さもなくば、液体材料が仕切部材で囲まれた領域に濡れ拡がらず、特にＥＬ素子のような表示素子では画素における色抜けや色むらが生じてしまう。

【０００９】このような問題に対して、例えば、特開平９－２０３８０３号公報、特開平９－２３０１２９号公報には、仕切部材の上部を撥液性にし、それ以外の部分が親液性となるように表面処理をする技術が提案されている。

【００１０】これらの従来例はともに、仕切部材の上面に撥液性の材料からなる層（フッ素化合物からなる層）を形成するもので、特開平９－２０３８０３号公報には、非親和性を示す層を仕切部材の上部に塗布し、仕切部材で囲まれた領域の表面を親水性基界面活性剤で処理する技術が記載されており、特開平９－２３０１２９号公報には、更に紫外線照射により仕切部材で囲まれた凹部を親和性にする技術が記載されている。その論理的考察については、International Display ResearchConference 1997, pp238-241に記載されている。

【００１１】しかしながら、前記従来技術におけるように、仕切部材上面の撥液性及び仕切部材で囲まれる領域の親液性がある程度実現されたとしても、例えば、インクジェット方式を用いて液体材料を塗布する場合は、吐出される液滴の大きさと、上記仕切部材表面やこれに囲まれる領域の面積に対して極端に大きいあるいは小さいなど、これらのバランスが著しく悪い場合は、液体材料が被塗布領域に正確に充填されず、精度の高いパターニングが不可能となることがわかった。例えば、上記液滴の大きさが仕切部材に囲まれる領域よりも大きく成り過ぎると液滴が仕切部材上に乗り上げ、更に仕切部材上部表面が狭い場合は液滴が目的とする被塗布領域に隣接する領域に溢れ出てしまう。

【００１２】このように、液滴の大きさと、仕切部材やこれに囲まれる領域の面積との関係が適性でない場合は、上記のような問題に起因して仕切部材で囲まれた領域間での薄膜材料液の混合や形成する薄膜毎に膜厚のばらつきを生じることとなる。

【００１３】また、仕切部材で区画された領域に薄膜材料を充填する際には仕切り部材の薄膜材料液に対する親和性に関して更に問題も生じる。

【００１４】仕切部材や仕切部材で囲まれた領域が、薄膜材料液に対してどのような濡れ性（親和性）を示すかで充填された薄膜材料液の挙動が異なる。既述したように、仕切部材の表面が薄膜材料液に対し親和性（親水性）を示すと、仕切部材の高さを超える量の材料を充填した場合に、仕切部材があっても薄膜材料液は容易に隣接する仕切部材で囲まれた領域に流出してしまう。逆に仕切部材の表面が薄膜材料液に対し適度に非親和性（撥水性）を示すと、仕切部材の高さを超える量の材料を充填しても材料の表面張力により隣の仕切部材で囲まれた領域に薄膜材料液が流れ出すことはない。

【００１５】そしてより具体的な基板表面の改質法として特定の性質を得るため当該表面のカラーフィルターの製造、例えば、既述した特開平９－２０３８０３号公報、特開平９－２３０１２９号公報、更には特開平９－２３０１２７号公報に記載されているもの、すなわち、バンク表面をフッ素系化合物で撥インク処理する方法であって、バンクで囲まれる領域を親水性基を有する界面活性剤等で処理する技術（特開平９－２０３８０３号公報）、エッチングにより処理する方法（特開平９－２３０１２７号公報）、あるいはエネルギー照射（特開平９－２３０１２９号公報）により親インク処理があげられる。

【００１６】しかしながら、特に、フッ素系化合物材料を用いて部材表面を撥インク性にする場合、あるいはフッ素系化合物材料を用いて部材を形成する場合、前記フッ素系材料と部材を形成する下地層あるいは下地基板との密着性が悪くなり基板上にバンクを形成する技術へ応用を考えると問題がある。また、部材、特にバンク自体を撥インク性のフッ素系化合物材料等で形成できたとしてもフォトリソグラフィーによるパターニング後、バンク領域に残さが生じバンク表面の親インク性が損なわれるおそれがある。

【００１７】また、上記公知技術では仕切部材上部を非親和性にするためだけに非親和性を示す材料の塗布、乾燥、除去等が必要となり、工程数が多くならざるを得なかった。また、紫外線照射を行う場合には多くの材料で親和性となる傾向がある。材料が非親和性材料であっても紫外線照射により若干親和性を生ずるようになり、折角の非親和性処理が無駄になる傾向があった。特に、特開平９－２３０１２９号公報には紫外線を表裏の両面から照射することで親和性の程度を制御する旨が規定されているが、非親和性と親和性との親和性の制御、例えば薄膜材料液に対する接触角をそれぞれどのように設定するかについては不明であった。

【００１８】また、仕切部材の撥液性が強い場合、仕切部材の側壁で薄膜材料の液がはじかれるため、成膜後の厚みが仕切部材で囲まれた領域の中央部で厚く周辺部で薄くなる。これでは、表示素子に画素での色むらが生じる。特に、ＥＬ素子においてはショートが生じ易く信頼性の低下につながる。

【００１９】仕切部材の表面に撥液処理を施して、その側面に親和性（親液性）を付与した場合には、薄膜材料を提供して成膜後の厚みが仕切部材で囲まれた領域の周辺で薄くなることはないが、薄膜材料の液の大部分が仕切部材の側面に引っ張られるため、薄膜の裾部分、即ち、基板と接する部分で膜厚がより大きくなるだけではなく、膜厚の制御が困難となることもない。

【００２０】有機物質の表面エネルギー（濡れ性）の改質方法として、プラズマ処理を行うことはよく知られている。このような表面改質方法としては、例えば、特開昭６３－３０８９２０号公報に記載されているものがある。この公報に記載された表面改質方法は、フッ素系ガスと酸素ガスを含む混合ガスプラズマを用いて有機物質表面を処理し、前記混合ガスの混合比を変えることにより、前記有機物質の表面エネルギーを制御するものである。

【００２１】また、ガラスやＩＴＯ（Indium Tin Oxida）などの無機物表面を親水化するためにＵＶ照射や酸素プラズマ処理をする方法も良く知られた手法である。

【００２２】しかしながら、同一基板上に有機物或いは無機物からなる層のパターンを設ける場合、この基板においてプラズマ処理やＵＶ照射により各々の材料の濡れ性を簡便かつ厳密に制御する技術は報告されていない。混合ガスプラズマ処理により有機物質表面あるいは有機物で形成される部材表面に撥インク性を付与する方法では、効率よく撥インク性を付与することができなかったり、表面の撥インク性が一過性であり、熱工程を経たり、時間が経過すると撥インク性が劣化するという問題がある。

【００２３】また、エネルギー照射により、親インク処理を行う場合、バンク表面の撥インク性を損なうおそれがあり、バンク表面の撥インク性とバンク表面の親インク性を同時に達成することは困難である。

【００２４】このように異なる薄膜材料を供給し、所定のパターンの薄膜を形成する方法、特に基板上に形成された仕切部材（バンク）で囲まれた領域に薄膜材料液を

充填し、薄膜を形成する方法においては、バンク、凹部の濡れ性（撥インク性と親インク性）を適切に制御することが重要である。バンクに撥インク性がなければ、バンク上にインク残さを生じるだけでなく、バンクを挟んで隣接する凹部に異なる薄膜材料液を充填する場合、該バンクを乗り越えて異なる薄膜材料液が互いに混合してしまうことになる。このような場合が生じると、所望の特性を有する薄膜を形成することができない。

【００２５】一方、バンクを挟んで隣接する凹部に異なる薄膜材料液を用いて薄膜を形成する例として、カラー有機ＥＬ素子や、液晶表示装置に用いられるカラーフィルターなどが挙げられるが、これらを製造する場合、バンクは撥インク性でありかつバンクで囲まれる領域つまりＩＴＯやガラス基板表面上は親インク性でなければならない。凹部に親インク性がなければ画素内での濡れ広がりが悪く色抜けや膜厚ムラの原因となる。

【００２６】さらに上記方法では撥インク処理に加え、さらに画素領域つまり凹部の親インク処理工程が必要となり、供給するインクの制御が困難であることや工程が多くなってしまうという難点を有する。

【００２７】本発明はこのような状況下で、成し遂げられたものである。本発明は、特性の異なる薄膜を同一基板上にパターニング成膜する場合、薄膜材料液体がバンクを超えて流れ出るという事態を防止し、平坦且つ均一厚みの色むらなどの無い安定した特性の薄膜層を確実に高精度に比較的簡単に歩留まり良く形成でき、高精細な微細パターニングを可能とすることを主要な目的とする。

【００２８】本発明の第１の目的は、有機半導体材料や着色樹脂等の薄膜をインクジェット方式やバブルジェット（登録商標）方式などの吐出方式により形成する際に、薄膜領域毎での混合が起こらず膜厚のばらつきが著しく少なく高精度にパターニングされた、有機ＥＬ素子、カラーフィルタ等の薄膜素子を提供することにある。また、この目的に付随して、本発明は、この薄膜素子を製造することに供される薄膜パターニング用基板、この薄膜素子を備えた表示装置、さらにこの薄膜素子を得るための薄膜形成方法を提供することも目的とする。

【００２９】さらに、本発明の第２の目的は、半導体素子、電子デバイスなどの配線などの導電薄膜をスピンコート法やディップ法で形成する際に、更に微細なパターニングを可能にする基板薄膜素子、薄膜形成方法、この方法で形成した薄膜素子、この薄膜素子を備えた表示装置、および、この表示装置を備えた電子機器をそれぞれ提供することにある。

【００３０】本発明の第３の目的は、簡便かつ適切な濡れ性の制御を目的としたバンクを形成した基板の表面改質方法、及びこの表面改質方法を利用して薄膜を形成する方法、並びにこの薄膜を備えた表示素子・表示装置及びこれらの製造方法を提供することである。

【００３１】本発明の第４の目的は、プラズマ処理を一定条件で管理することで、バンク自体はバンク形成面との高い密着性を保ちながら、親和性制御のために多数の工程を経ることなくバンクとバンク形成面との親和性を確実に制御することができる薄膜形成方法を提供することである。これにより、薄膜材料液がバンクを超えて流れ出ることを防止し、歩留まりを向上させ、製造コストを減少させることである。

【００３２】本発明の第５の目的は、プラズマ処理を一定条件で管理することでバンクとバンク形成面との親和性を確実に設定することにより、薄膜材料液がバンクを超えて流れ出ることが防止でき、かつ均一な厚みの薄膜層を有する表示装置を提供することである。これにより、明るさや色にむらが生じない画像表示が行え、信頼性を向上させることである。

【００３３】

【課題を解決するための手段】本発明者らは、前記第１目的を達成するために鋭意研究を重ねた結果、既述の吐出方式を用いた薄膜形成において、液体材料に対する上記仕切部材表面の撥液性及び仕切部材で囲まれる領域の親液性を調節するのみならず、更に、吐出される液体材料の液滴の大きさと、仕切部材及び該仕切部材で囲まれる領域の面積との関係を最適化することにより、上記本発明の第１の目的を達成しうることを見出したものである。

【００３４】また、スピンコート法やディップ法を用いた薄膜形成においては、液体材料に対する前記仕切り部材及び仕切り部材で囲まれる領域の濡れ性の制御に加え、この液体材料の表面張力を特定の値に調整することにより、上記本発明の第２の目的を達成しうることを見出したものである。本発明はかかる知見に基づいて完成したものである。

【００３５】すなわち、本発明は前記第１目的を達成するために、基板上に、所定の高さのバンク、及び該バンクにより区切られた被塗布領域にインクジェット法により薄膜層のパターンを形成する薄膜パターニング基板或いはこのパターニング基板に形成された表示素子であって、上記バンクの幅をａ（μｍ）、その高さをｃ（μｍ）とし、被塗布領域の幅をｂ（μｍ）とし、かつ、薄膜層を形成する液体材料の液滴径をｄ（μｍ）とするとき、上記バンクが、次の特性を持つことを特徴とするものである。

【００３６】（１）　バンクが、ｄ／２＜ｂ＜５ｄを満足するように基板上に形成されてなる。この特性範囲を満たすことによって、液体材料がバンクに乗り上げず、画素内の混色が防止される。さらに、次の特性の少なくとも一つがこの特性に付加される。

【００３７】（２）　ａ＞ｄ／４：　ｂが小さい場合、ａ＞ｄ／４ならば、液体材料はバンクに乗り上げることがあるが、被塗布領域内の薄膜材料の混合が防止される。

【００３８】（３）　ｃ＞ｔ$_0$　（ｔ$_0$（μｍ）は薄膜層の膜厚）

（４）　ｃ＞ｄ／（２ｂ）

なお、ストライプまたは四角形の被塗布領域の場合、上記パラメータａ，ｃは一定になるが、画素がサークルの場合、パラメータａは画素間最短距離であり、パラメータｃは直径になる。

【００３９】前記第２目的を達成するための本発明は、基板上に形成された所定の高さのバンクと、このバンクによって区切られた被塗布領域と、この領域に、ディップ法又はスピンコート法により形成される薄膜層と、を有するように構成されてなる薄膜素子において、所定の表面処理（濡れ性の制御）がなされた基板を用い、前記薄膜層を、表面張力が３０ｄｙｎｅ／ｃｍ以下の液体材料を用いて、形成してなることを特徴とする。

【００４０】液体材料の表面張力をこの範囲にすることにより、数ミクロン以下の幅でパターニング薄膜の形成がスピンコート法やディップ法で可能になる。

【００４１】本発明では、これらの薄膜素子を得るための薄膜形成方法、この薄膜素子を表示素子として備える表示装置、さらに、この表示装置を備える電子機器が提案される。

【００４２】前記第３以降の目的を達成するものとして、本発明者がなし得た後述する発明に共通する発明概念は、基板においてバンクで囲まれた領域に薄膜形成材料を充填するための表面改質方法であって、バンクが形成された基板全表面に一連の表面改質処理を均一に行い、この一連の処理によりバンク部分表面の薄膜形成材料に対する非親和性を、バンク間部分の表面のそれに対して高める工程を有する表面改質技術、又はこの表面改質技術を利用した薄膜形成技術、又はこれを利用した薄膜パターニング基板、又はこれを利用したＥＬ素子等の表示素子、又はこの素子を利用した表示装置である。

【００４３】既述の従来例が、例えばパターニングの前のフォトレジスト上全面に撥水処理を行った後パターニングして表面処理されたバンクパターンを得たり、バンク形成後マスクを施して表面処理を行うのに対して、この本発明によれば、予め形成されたバンクを有する基板表面のほぼ全面に一律に一連の処理を行い、プラズマ処理等表面処理の途中で表面処理とは異種の工程が関与しないようにして、一気に目的とする表面処理を行うことができる。ここで、一連の表面改質処理とは、後述のように、好適には、無機材料で構成されたバンク形成面に有機材料からなるバンクが形成された基板に後述のプラズマ処理を一気に適用する処理である。

【００４４】そこで、前記第３の目的を達成する発明は、基板においてバンクで囲まれた領域に薄膜形成材料を充填するための表面改質方法であって、無機材料で構成されるバンク形成面に有機材料でバンクを形成するバンク形成工程と、所定の表面処理を行った場合に、バンクがバンク形成面に比べて薄膜材料液に対する非親和性の程度がより高くなるような一定条件下でバンクおよびバンク形成面に対して表面処理を施す表面処理工程と、を備えることを特徴とする。

【００４５】さらに、この発明の他の形態は、バンクで囲まれた領域に薄膜材料液を充填して薄膜層を形成する薄膜形成方法であって、無機材料で構成されるバンク形成面に有機材料でバンクを形成するバンク形成工程と、所定の表面処理を行った場合に、バンクがバンク形成面に比べて薄膜材料液に対する非親和性の程度がより高くなるような一定条件下でバンクおよびバンク形成面に対して表面処理を施す表面処理工程と、表面処理がされたバンクで囲まれる領域に薄膜材料液を充填して薄膜層を形成する薄膜層形成工程と、を備えることを特徴とする。

【００４６】ここでバンクとは、既述のとおり、例えば有機半導体薄膜素子を利用した表示装置の画素を仕切るために設けたり、カラーフィルタの画素領域を仕切るために設けたりする仕切部材のことをいう。バンク形成面とはこのバンクを設ける面のことで、表示装置等の駆動基板であってもカラーフィルタ等の透明基板等であってもよい。

【００４７】表面処理としては、例えば導入ガスにフッ素またはフッ素化合物を含んだガスを使用し、減圧雰囲気下や大気圧雰囲気下でプラズマ照射をする減圧プラズマ処理や大気圧プラズマ処理を行う。一定条件としては、フッ素系化合物および酸素を含んだガス中でプラズマ処理が行われることが挙げられる。この条件下では無機材料の表面にはプラズマ放電により未反応基が発生し、酸素により未反応基が酸化されてカルボニル基や水酸基等の極性基が発生する。極性基は水等の極性分子を含んだ流動体に対して親和性を示し、非極性分子を含んだ流動体に対し非親和性を示す。有機材料表面においても上記のような反応と並行してフッ素系化合物分子が有機材料表面に入り込む現象も生ずる。特にフッ素系化合物が酸素よりも多い場合、例えばフッ素系化合物および酸素の総量に対するフッ素系化合物の含有量が６０％以上に設定されていると、フッ素系化合物の量が過多のガス雰囲気化では酸素による酸化反応よりも、フッ素系化合物の混入化現象の方が盛んになるため、酸化反応による影響よりも混入化現象により表面が非極性化される。したがって有機材料をフッ素系化合物が過多の条件でプラズマ処理すると、極性分子を含んだ流動体に対して非親和性を示し、非極性分子を含んだ流動体に対して親和性を示すようになる。

【００４８】フッ素またはフッ素化合物を含んだガスとしては、例えばCF_4、SF_6、CHF_3等のハロゲンガスを用いる。この条件下で表面処理を施すと有機材料と無機材料との間で流動体に対する接触角が大きく異な

るようにその表面の親和性が調整される。上記表面処理により薄膜材料液のバンク形成面に対する接触角が２０度以下になるように表面処理の条件が設定される。また薄膜材料液のバンク形成面に対する接触角が５０度以上になるように表面処理の条件が設定される。バンクが二層で形成される場合、表面処理により、バンク下層の薄膜材料液に対する親和性が画素電極のそれ以下であってバンク上層のそれ以上に設定される。例えばバンク上層の表面が薄膜材料液に対し接触角が５０度以下になるように表面処理の条件が設定される。バンク下層の表面が薄膜材料液に対し接触角が２０度乃至４０度の範囲になるように表面処理の条件が設定される。

【００４９】ここで親和性であるか非親和性であるかは、充填する薄膜材料液がどのような性質を備えているかで決まる。例えば親水性のある薄膜材料液であれば、極性基を有する表面が親和性を示し、非極性基を有する表面が非親和性を示す。逆に親油性のある薄膜材料液であれば、極性基を有する表面が非親和性を示し、非極性基を有する表面が親和性を示す。薄膜材料を何にするかは、製造対象によって種々に変更して適用することになる。

【００５０】好ましくは、バンク形成工程は、バンクを上層および下層の二層で形成する。具体例としてこのバンク形成工程は、バンク形成面に下層膜を形成する下層膜形成工程と、下層膜上でバンクの形成領域に合わせて上層を形成する上層形成工程と、上層をマスクとして当該上層が設けられていない領域の下層膜をエッチングして除去する除去工程と、を備える。

【００５１】また別の具体例としてバンク形成工程は、バンク形成面に下層膜を形成する下層膜形成工程と、当該下層膜をバンク下層の形成領域に合わせて露光・現像する工程と、下層を覆って上層膜を形成する上層膜形成工程と、当該上層膜をバンク上層の形成領域に合わせて露光・現像する工程と、を備える。

【００５２】適用例としてバンクで囲まれる領域には画素電極が設けられ、薄膜材料液は薄膜発光素子を形成するための有機半導体材料である場合が挙げられる。これは有機半導体表示装置である。このとき例えば画素電極はＩＴＯ電極膜である。具体的には、バンクはポリイミドなどの絶縁有機材料であることが好ましい。またバンク下層を設ける場合には、シリコン酸化膜、シリコン窒化膜またはアモルファスシリコンを用いる。

【００５３】さらに前記第４の目的を達成する本発明は、基板上に形成されたバンクで囲まれた領域に薄膜材料液を充填するための表面改質方法であって、バンクが形成された基板に、酸素プラズマ処理を行う第一工程とこれに続けてフッ素系ガスプラズマ処理を行う第二工程とを備えた表面改質方法を提供するものである。

【００５４】この方法によれば、酸素ガスプラズマ処理により、まずガラス、ＩＴＯなどの無機物基板の表面を

前記薄膜材料液に対して親液性（親和性）にすることができる。

【００５５】前記第一工程で行う酸素プラズマ処理は、基板上にバンクを有機物で形成した場合の残さをアッシングするだけでなく有機物表面を活性化することにより、続けて行われるフッ素系ガスプラズマ処理による撥液化を効率よく行うために有効である。

【００５６】前記第二工程でフッ素系ガスプラズマ処理を行うことにより有機物表面がフッ素化（テフロン化）され半永久的な撥液性を有機物に付与することができる。このフッ素系ガスプラズマ処理により基板上の親液性は損なわれることはなく、簡便な方法で同一基板上に選択的に親液性、撥液性の表面を形成することができる。

【００５７】また、少なくとも前記第一工程及び第二工程のいずれかのプラズマ処理は、大気圧下で処理される大気圧プラズマとすることができる。あるいは、少なくとも前記第一工程および第二工程のいずれかのプラズマ処理は、減圧下で処理される減圧プラズマとすることができる。

【００５８】また、基板上の汚染の程度が低ければ、フッ素プラズマ処理だけでもよい。特に、減圧プラズマでは、基板表面は洗浄され、バンクを形成する有機物をテフロン化することができる。

【００５９】前記基板は、無機物から構成することができる。この無機物からなる基板表面を親液化することもできる。

【００６０】前記基板上に形成されたバンクにおいて、少なくとも該バンクの上面を有機物で形成することができる。あるいは、前記基板上に形成されたバンクにおいて、該バンクの上面および側面を有機物で形成することもできる。さらにまた、前記基板上に形成されたバンクにおいて、当該バンクを下層の無機物と上層の有機物の２層で形成することもできる。また、前記基板上に形成されたバンクにおいて、当該バンクを下層の無機物と上層の有機物の２層で形成し、当該無機物の少なくとも側面を該有機物で覆われていないようにすることもできる。

【００６１】また、前記バンクを形成する有機物表面は、撥液化（非親和性）にすることができる。そしてまた、前記バンクを形成する有機物表面は、テフロン化することもできる。さらにまた、前記バンクを形成する有機物表面を撥液化し、かつ前記無機物からなる基板表面を親液化することもできる。

【００６２】バンクを形成する有機材料にはもともと撥液性の材料を使う必要がないので材料選択の幅が広がる。

【００６３】また、処理時間、ガスの種類、ガス流量、プラズマ強度、プラズマ電極と基板距離等の条件により容易に表面エネルギー（親液性、撥液性）を制御でき

る。

【００６４】前記薄膜材料液の前記基板表面に対する接触角を３０度以下に、前記バンク表面に対する接触角を５０度以上にすることができる。

【００６５】前記薄膜材料液の基板表面に対する接触角が３０度を超えると、薄膜材料液がバンクで囲まれた基板上に全面濡れ広がらない或いは均一に濡れ広がらず膜厚ムラを生じる。一方、前記薄膜材料液の前記バンク表面に対する接触角が５０度より低いと、薄膜材料液がバンク上部にも付着したり、あるいはバンク側に引っ張られバンクを超えて隣接する基板内に流出してしまうことになる。つまり前記薄膜材料液の所望の場所へのパターニングができなくなってしまう。

【００６６】また、バンクを２層から形成し、下層に無機材料を用い、接触角で２０度～５０度になるように制御することにより、バンク裾で膜がついてない或いは薄くなってしまう問題を解決することができる。

【００６７】よって上記表面改質方法によりバンクで囲まれた領域にインクジェット法あるいはスピンコート等の塗膜方法により薄膜材料液を高精度にパターニングすることが可能となる。上記表面改質を行った基板とインクジェット法による薄膜形成法を用いれば簡便かつ低コストで高精細なカラーフィルターならびにフルカラー有機ＥＬ素子を製造することが可能となる。

【００６８】またさらに第５の目的を達成する本発明は、基板上に形成されたバンクで囲まれた領域に薄膜材料液を充填し、薄膜を形成する方法であって、前述した表面改質が施された基板のバンクで囲まれた領域に、当該表面改質後直ちにインクジェット方式によって前記薄膜材料液を充填する工程を備えた薄膜形成方法を提供するものである。

【００６９】また、第５の目的を達成するめ、本発明は、基板上に形成されたバンクで囲まれた領域に薄膜材料液を充填し、薄膜を形成する方法であって、前述した表面改質が施された基板のバンクで囲まれた領域に、当該表面改質後直ちにスピンコート法あるいはディップ法等によって前記薄膜材料液を充填する工程を備えた薄膜形成方法を提供するものである。

【００７０】さらにまた、第５の目的を達成するため、本発明は、前述した薄膜形成方法により形成した薄膜を備えた表示装置を提供するものである。この表示装置は、カラーフィルターや、有機ＥＬ素子からなることができる。

【００７１】また、本発明は、第５の目的を達成するため、前述した薄膜形成方法により薄膜を形成する表示装置の製造方法を提供するものである。

【００７２】

【発明の実施の形態】以下に、特許請求の範囲の請求項１～２９に記載の発明を実施した第１～第３の実施例およびその変形例を説明する。

【００７３】（１）：第１の実施例（インクジェット法を用いる態様）

本発明の表示装置は、基板上に、所定の高さのバンク、及び該バンクにより区切られた基板表面にインクジェット法により形成される薄膜層を有する表示装置において、上記バンクの幅をａ（μｍ）、その高さをｃ（μｍ）とし、上記バンクに区切られる被塗布領域の幅をｂ（μｍ）とし、かつ、薄膜層を形成する液体材料の液滴径をｄ（μｍ）とするとき、上記バンクが、ａ＞ｄ／４、ｄ／２＜ｂ＜５ｄ、ｃ＞ｔ$_0$　（ｔ$_0$　（μｍ）は薄膜層の膜厚）、及びｃ＞（１／２）×（ｄ／ｂ）の各々の式を満足するように基板上に形成されたものである。

【００７４】図１はインクジェット法により本発明の表示装置を形成する際の基板に設けられたバンクと液滴の関係を説明するための模式図である。

【００７５】（ａ）バンクの構成

本発明の表示装置に用いた基板上に設けられたバンク（凸部または仕切り部材とも呼ばれる）は、例えばフルカラー有機ＥＬ素子を利用した表示装置の画素、或いは、カラーフィルタの画素領域を仕切るために設けられる仕切部材をいう。図１に示すように、上記バンクの幅をａ（μｍ）とすると、その値はインクジェット法における吐出液の液滴径ｄ（μｍ）に対してａ＞ｄ／４、すなわち、液滴径の４分の１より大きい値であることが、液体材料が隣接する画素領域に溢れることなく均一な塗布を行う上で必要である。

【００７６】バンクは基板上にその高さがｃ（μｍ）として設けられるが、その値は形成しようとする薄膜層の厚みｔ$_0$　（μｍ）より大きく、後述の被塗布領域の幅をｂ（μｍ）としたときに、ｃ＞（１／２）×（ｄ／ｂ）、すなわち、液滴径と被塗布領域の幅との比の２分の１より大きい値、となるように設けることが、本発明の目的を達成する上で好ましい。表面粗さはなるべく薄い方が好ましいことを考慮すると、ｃは、２ミクロン以下である。

【００７７】本発明においては、インクジェット法における塗布に際して、例えば、赤，緑，青の３色の色素あるいは有機半導体発光材料を同時に塗布する場合に隣接する画素領域へ液体材料が溢れることにより、混色が生じるのを避けるためバンク表面に所定の液滴溜を設けることが好ましい。液滴溜は、例えば、バンクの上部表面の、好ましくは中央部分に溝状に設けることが好ましく、その形状としては、図２に示すようなものが例示される。すなわち、図２Ａ～２Ｃは、上記液滴溜を有するバンクの断面図であるが、図２Ａはその断面がＶ字形状のものであり、図２Ｂは凹形状のものであり、図２ＣはＵ形状あるいは半球形状のものである。

【００７８】このような液滴溜を設けることにより、インクジェット法により塗布する際、液体材料が目的とす

る画素から溢れ出たとしても、液滴溜に捉えられ、また液滴がバンク上に乗り上げたとしても同様に液滴溜に捉えられる。この結果、表示素子の混色を避けることができる。

【００７９】バンクは、仕切部材として機能する部材であり、液体材料に対して撥液性を示す材料でも良いし、後述するように、プラズマ処理による撥液化（テフロン化）が可能で下地基板との密着性が良くフォトリソグラフィによるパターニングがし易いポリイミドなどの絶縁有機材料が好ましい。カラーフィルタ等では、仕切部材は遮蔽機能を兼用させてもよい。遮蔽部材として形成するためには、ブラックマトリックス用の材料はクロム等の金属や酸化物を用いる。

【００８０】バンクの形成はリソグラフィ法や印刷法等、任意の方法で行うことができる。例えば、リソグラフィ法を使用する場合は、スピンコート、スプレーコート、ロールコート、ダイコート、ディップコート等所定の方法でバンクの高さに合わせて有機材料を塗布し、その上にレジスト層を塗布する。そして、バンク形状に合わせてマスクを施しレジストを露光・現像することによりバンク形状に合わせたレジストを残す。最後にエッチングしてマスク以外の部分のバンク材料を除去する。また、下層が無機物で上層が有機物で構成された２層以上でバンク（凸部）を形成してもよい。

【００８１】（ｂ）基板の構成

バンクは基板上に形成される。基板としては、表示装置に使用する薄膜トランジスタ（ＴＦＴ：Thin Film Transistor）が形成された駆動基板であっても、カラーフィルタに使用する透明基板であってもよいが、その表面がバンクとの密着性の高い部材で形成されていることが好ましい。特に、無機材料で構成されていることが、後述の表面処理において好適な親和性を得る点で好ましい。このようなものとして、例えば、表示装置であれば透明電極であるＩＴＯなどが、カラーフィルタであればガラスや石英等でが挙げられる。

【００８２】（ｃ）被塗布領域及び薄膜層の構成

本発明の表示装置は、上記バンクにより区切られた基板表面、すなわち被塗布領域にインクジェット法により液体材料を用いて形成された薄膜層を有する。上記被塗布領域を形成する基板については上述の通りである。本発明においては、薄膜層を形成する液体材料のインクジェット液滴径をｄ（μｍ）とするとき、被塗布領域の幅ｂ（μｍ）をｄ／２＜ｂ＜５ｄの範囲の値とすることが必要である。ｂの値がｄ／２（μｍ）以下であるときは液滴が被塗布領域に溢れ、バンクを介して隣接する画素領域に流出してしまったり、たとえバンクに撥液性があったとしても、液滴がバンクの上に乗り上げてしまう等の問題が生じる。また、ｂの値が５ｄ（μｍ）以上であるときは液滴は被塗布領域に広がるが膜厚が薄くなり、所望の膜厚を得るためには複数回の重ね打ちが必要となり不経済である。また場合によっては、均一に濡れ広がらないこともある。

【００８３】本発明においては、上記被塗布領域は上記の大きさを有するものであれば、その形状については特に制限はなく、四角形（長方形，正方形，菱形を含む）、多角形（５角形、６角形等）、円形（真円形，楕円形を含む）等の環状形状、十字形、その他これに類する形状等いかなる形状も可能であるが、インクジェット法による塗布方式においては、液滴が濡れ易い形状であることが好ましいことから、特に、エッジ部（例えば、四角形における角部や頂点部）を有する形状のものにおいては、該エッジ部を曲面としたものが好ましい。このようにすることで、液体材料が被塗布領域に充填された時に、上記エッジ部分をぬれやすくすることができる。

【００８４】上記被塗布領域には液体材料が塗布され薄膜層が設けられるが、その適用例としては、有機ＥＬ表示装置があり、ここにおいては、薄膜層は画素電極であり、液体材料は薄膜発光素子を形成するための有機半導体材料である。この際、例えば、上記画素電極はＩＴＯ電極膜である。

【００８５】（ｄ）表面処理

本発明においては、バンク表面が被塗布領域に比べて液体材料に対する非親和性の程度がより高くなるように、バンク及び被塗布領域の基板材料に表面処理を施しておくことが好ましい。このような表面処理により液体材料のバンク表面に対する接触角を５０度以上とし、また被塗布領域の基板材料に対する接触角を２０度以下とすることが好ましい。このようにすることにより、薄膜層の厚さに比べて多量の液体材料を吐出しても、液体材料がバンクを乗り越え溢れでることもなく、所定の被塗布領域のみに充填される。

【００８６】上記表面処理としては、例えば導入ガスにフッ素またはフッ素化合物を含むガスを使用し、フッ素化合物及び酸素を含む減圧雰囲気下あるいは大気圧雰囲気下でプラズマ照射をする減圧プラズマ処理や大気圧プラズマ処理が挙げられる。フッ素またはフッ素化合物を含むガスとしては、CF_4，SF_6，CHF_3等が挙げられる。

【００８７】（ｅ）薄膜形成

本発明においては、上記バンクで仕切られた被塗布領域に、インクジェット法により液体材料を塗布し薄膜層を形成する。インクジェット法を用いることにより、任意の被塗布領域に任意の量で液体材料を充填することができ、また、家庭用プリンタに使用されるような小型の装置で充填が可能となる。本発明においては、吐出される液滴の径ｄ（μｍ）に対して、バンク及び該バンクに仕切られる被塗布領域の形状，大きさを最適化することにより、隣の画素との混色が起こらず、各画素毎の膜厚のばらつきのない薄膜層が得られるのである。

【００８８】インクジェット法における吐出量は、塗布後の加熱処理により体積が減少した際に、所望の厚みになるような量とする。場合によっては所望の厚みになるように乾燥後の重ね合わせ処理をしても良い。インクジェット式記録ヘッドから吐出させるには通常粘度が数ｃＰである。

【００８９】本発明においては、吐出された液滴の大きさに対し、バンクの大きさ及び被塗布領域の幅を規定することにより、薄膜層の厚さに比べて多量の液体材料を吐出しても、液体材料がバンクを乗り越え溢れでることなく、所定の被塗布領域に充填されることとなる。液体材料を充填した後、溶媒を含む材料の場合は加熱処理および／または減圧処理を行い溶媒成分を除去することにより、液体材料の体積が減少し、被塗布領域に薄膜層が形成される。この時、被塗布領域の表面、すなわち基板表面は前述のように親液性を示すように表面処理されているので薄膜層が好適に密着する。使用しうる液体材料としては、表示装置の場合は有機半導体材料が、またカラーフィルタの場合は着色材料等が使用できる。有機半導体材料としては、例えば、赤，緑，青より選択された発光を有する有機発光材料が用いられる。

【００９０】なお、インクジェット方式としては、ピエゾジェット方式であっても熱による気泡発生により吐出する方法のいずれも使用できるが、加熱による流動体の変質がない点でピエゾジェット方式が好ましい。

【００９１】（２）：第２の実施例（ディップ法又はスピンコート法を用いる態様）

本発明者らは、基板上に、所定の高さのバンク、及び該バンクにより区切られ被塗布領域を設け、所望の表面処理を行い、ディップ法又はスピンコート法により形成される薄膜層を有する表示装置において、上記薄膜層が表面張力が３０ｄｙｎｅ／ｃｍの液体材料を用いて形成されたことを特徴とする薄膜形成方法によっても、本発明の目的が達成されることを見出した。特に、上記表示装置は、インクジェット方式を用いた塗布の場合と異なり、バンクあるいは被塗布領域の形状あるいは大きさに何ら限定を加えることなく、バンク、基板の表面エネルギに加え、液体材料の表面エネルギを制御することにより、上記目的を達成し、上記インクジェット法に比較しても更に微細なパターニングを可能とするものである。特に、上記表面張力の範囲に制御することにより、金属配線等の微細パターニングに有効に用いられることとなり、数μｍ幅でのパターニングが可能となる。また、有機ＥＬ素子製造に用いられる正孔注入層がＲ，Ｇ，Ｂで共通の材料を用いる場合にも有効である。

【００９２】ここに用いる基板、バンク、被塗布領域材料については、その材質は前記インクジェット法を用いた塗布の場合と同様である。また、バンク表面及び被塗布領域にインクジェット法の場合と同様の表面処理を行うことが好ましい。従って、バンク及び被塗布領域である基板は、各々、液体材料に対して５０度以上、３０度以下の接触角を有するものであることが好ましい。ディップ法及びスピンコート法の各々は、通常当業界で行われる方法で行うことができる。

【００９３】（３）：第３の実施例（表示装置の具体的実施形態）

本発明の表示装置の具体的構成について以下に説明する。

【００９４】（構成）図３は本実施形態におけるアクティブマトリックス型表示装置の全体のレイアウトを模式的に示すブロック図である。図４は図３における画素の一つを示す平面図、図５Ａ～５Ｃはそれぞれ図４の切断面Ａ－Ａにおける断面図、切断面Ｂ－Ｂにおける断面図、切断面Ｃ－Ｃにおける断面図である。

【００９５】本実施形態のアクティブマトリックス型表示装置は、透明基板１０の中央部分に表示部１１を備えている。透明基板１０の外周部分には、データ側駆動回路３および走査側駆動回路４が設けられており、データ側駆動回路３からはデータ線ｓｉｇが表示部１１に配線され、走査側駆動回路４からは走査線ｇａｔｅが配線されている。これらの駆動回路３、４では、図示しないＮ型のＴＦＴとＰ型のＴＦＴとによって相補型ＴＦＴが構成されている。この相補型ＴＦＴは、シフトレジスタ回路、レベルシフタ回路、アナログスイッチ回路などを構成しており、外部から供給されるデータ信号及び走査信号を電力増幅可能に構成している。

【００９６】表示部１１には、液晶アクティブマトリックス型表示装置のアクティブマトリックス基板と同様、透明基板１０上に複数の画素７が配置されている。駆動回路３及び４からは、複数の走査線ｇａｔｅと複数のデータ線ｓｉｇが交差して配　されており、各画素７には一組のデータ線ｓｉｇと走査線ｇａｔｅが配されている。マトリックス状に交差しているデータ線ｓｉｇ及び走査線ｇａｔｅの他に、共通給電線ｃｏｍが各画素の近傍を通って配線されている。

【００９７】各々の画素７は、バンク（bank）層で囲まれた例えば直径５０μｍの円形の凹部に形成されている。画素を区切るバンク層はその幅ａが１０μｍであり、高さが２μｍであり、その材料は前述の通りである。また、液体材料（ＰＰＶ前駆体溶液をＤＭＦ，グリセリン，ジエチレングリコールで希釈しインク化したもの）としては、ポリ（パラ－フェニレンビニレン）（ＰＰＶ）前駆体溶液などの有機半導体材料溶液が用いられる。この液体材料をインクジェット法によりバンクで囲まれた被塗布領域に吐出し、加熱することにより有機半導体膜４３が形成される。また、正孔注入輸送層として、ポリエチレンジオキシチオフェンなどの導電性材料をインクジェット法あるいはスピンコート法より形成した積層構造であってもよい。

【００９８】各画素７は導通制御回路５０及び薄膜発光素子４０を備える。導通制御回路５０は、第１のＴＦＴ

２０、保持容量ｃａｐ及び第２のＴＦＴ３０を備えている。第１のＴＦＴ２０は、そのゲート電極に走査線ｇａｔｅを介して走査信号が供給されている。保持容量ｃａｐは、第１のＴＦＴ２０を介してデータ線ｓｉｇから供給される画像信号を保持可能に構成されている。第２のＴＦＴ３０は、保持容量ｃａｐによって保持された画像信号がゲート電極に供給されている。第２のＴＦＴ３０と薄膜発光素子４０とは対向電極ｏｐと共通給電線ｃｏｍとの間で直列接続されている。

【００９９】第１のＴＦＴ２０及び第２のＴＦＴ３０は、図４及び図５Ａ～５Ｃに示すように島状の半導体膜により形成されている。第１のＴＦＴ２０はゲート電極２１が走査線ｇａｔｅの一部として構成されている。第１のＴＦＴ２０はそのソース・ドレイン領域の一方には第１層間絶縁膜５１のコンタクトホールを介してデータ線ｓｉｇが電気的に接続され、他方には、ドレイン電極２２が電気的に接続されている。ドレイン電極２２は第２のＴＦＴ３０のゲート電極３１が第１層間絶縁膜５１のコンタクトホールを介して電気的に接続されている。第２のＴＦＴ３０はそのソース・ドレイン領域の一方には第１層間絶縁膜５１のコンタクトホールを介してデータ線ｓｉｇと同時形成された中継電極３５が電気的に接続されている。中継電極３５には第２層間絶縁膜５２のコンタクトホールを介して薄膜発光素子４０の透明電極４１が電気的に接続されている。透明電極としては例えばＩＴＯが用いられる。

【０１００】第２のＴＦＴ３０はそのソース・ドレイン領域のもう一方に第１層間絶縁膜５１のコンタクトホールを介して共通給電線ｃｏｍが電気的に接続されている。共通給電線ｃｏｍの延設部分３９は、第２のＴＦＴ３０のゲート電極３１の延設部分３６に対して、第１層間絶縁膜５１を誘電体膜として挟んで対向し、保持容量ｃａｐを構成している。なお、保持容量ｃａｐについては共通給電線ｃｏｍとの間に形成した上記構造の他、走査線ｇａｔｅと並列に形成した容量線との間に形成してもよい。また、第１のＴＦＴ２０のドレイン領域と第２のＴＦＴ３０のゲート電極３１とを利用して保持容量ｃａｐを構成してもよい。

【０１０１】バンク層で囲まれた薄膜発光素子４０は、各画素７ごとに独立して形成されている。薄膜発光素子４０は画素電極４１の上層側に、発光薄膜として有機半導体膜４３、及び対向電極ｏｐを順に積層して形成されている。有機半導体膜４３としては、電界の印加により発光する材料、例えばポリ（パラーフェニレン）（ＰＰＶ）が用いられる。なお、有機半導体膜４３は画素毎に設けられる他、複数の画素７にまたがるストライプ形状に形成されていてもよい。対向電極ｏｐには光を反射する導電性材料、例えばリチウム含有アルミニウム、カルシウム等の金属膜が用いられる。対向電極ｏｐは表示部１１全体及び少なくとも蛸子１２が形成されている領域を除いた領域に形成されている。

【０１０２】なお、上記薄膜発光素子４０としては、上述のように正孔注入層を設けて発光効率（正孔注入効率）を高めた構造や、電子注入層を設けて発光効率（電子注入効率）を高めた構造、正孔注入層及び電子注入層の双方を形成した構造を採用してもよい。

【０１０３】（表示装置の製造方法）次に、上記構成のアクティブマトリックス型表示装置の製造方法について説明する。

【０１０４】半導体層形成工程：　まず、透明基板１０に対して、必要に応じて、ＴＥＯＳ（テトラエトキシシラン）や酸素ガスなどを原料ガスとしてプラズマＣＶＤ法により厚さが約２０００～５０００オングストロームのシリコン酸化膜からなる下地保護膜を形成したのち、下地保護膜の表面にプラズマＣＶＤ法により厚さが約３００～７００オングストロームのアモルファスのシリコン膜からなる半導体膜を形成する。次に、アモルファスのシリコン膜からなる半導体膜に対して、レーザアニールまたは固定成長法などの結晶化工程を行い、半導体膜をポリシリコン膜に結晶化する。次に、半導体膜をパターニングして島状の半導体膜とし、その表面に対してＴＥＯＳ（テトラエトキシシラン）や酸素ガスなどを原料ガスとしてプラズマＣＶＤ法により厚さが約６００～１５００オングストロームのシリコン酸化膜または窒化膜からなるゲート絶縁膜３７を形成する。次に、アルミニウム、タンタル、モリブデン、チタン、タングステンなどの金属膜からなる導電膜をスパッタ法により形成した後パターニングし、ゲート電極２１、３１及びゲート電極３１の延設部分３６を形成する。この工程においては走査線ｇａｔｅも形成する。

【０１０５】この状態で、高濃度のリンイオンを打ち込んで、ゲート電極２１、３１に対して自己整合的にソース・ドレイン領域を形成する。なお不純物が導入されなかった部分がチャネル領域となる。次に、第１層間絶縁膜５１を形成した後、各コンタクトホールを形成し、データ線ｓｉｇ、ドレイン電極２２、共通給電線ｃｏｍ、共通給電線ｃｏｍの延設部分３９、及び中継電極３５を形成する。その結果、第１のＴＦＴ２０、第２のＴＦＴ３０、及び保持容量ｃａｐが形成される。

【０１０６】次に、第２層間絶縁膜５２を形成し、この層間絶縁膜に中継電極３５に相当する部分にコンタクトホールを形成する。次に、第２層間絶縁膜５２の表面全体にＩＴＯ膜を形成した後パターニングし、コンタクトホールを介して第２のＴＦＴ３０のソース・ドレイン領域に電気的に接続して画素電極４２を画素７毎に形成する。

【０１０７】絶縁膜形成工程：　次に、走査線ｇａｔｅ及びデータ線ｓｉｇに沿って絶縁膜６２を形成する。絶縁膜６２は、前記のポリイミド等の有機絶縁材料で構成する。絶縁膜６２は、その幅及び厚みとして、前述のように液体材料をインクジェット法で塗布する際の液滴径に対し、最適化した値を選択する。

【０１０８】表面処理工程：　次いで、画素電極４１の表面を液体材料に対して親和性（液体材料が水分を含むときは親水性）、例えば接触角で２０以下に、絶縁膜６２を液体材料に対して非親和性、例えば接触角で５０以上に設定すべくフッ素を含むガスを使用して前述のようにプラズマ処理を施す。

【０１０９】有機半導体（有機ＥＬ素子）膜形成工程：　上記表面処理後、バンクにより円形状に区画された被塗布領域内にインクジェット法を利用してＲ，Ｇ，Ｂに対応する各有機半導体膜４３を形成する。すなわち、バンク層に囲まれた円形状の被塗布領域に対してインクジェット式記録ヘッドから、有機半導体膜４３を構成するための材料である液体材料を吐出する。具体例として、赤色発光層材料としては、上記ＰＰＶ前駆体をインク化したものにローダミン、ペリレンなどの色素をドープしたもの、あるいはＰＰＶ前駆体（ＭＨＥ－ＰＰＶ）をインク化したものを用いた。青色発光層のための材料としては、ポリフルオレン誘導体をキシレン等の芳香族系溶媒に溶解しインク化したものを用いた。その液滴径は３０μｍφであった。

【０１１０】次いで、ＰＰＶ前駆体溶液（ＰＰＶ前駆体溶液をＤＭＦ希釈し、インク化したもの）の場合は、減圧下で溶媒を除去し、摂氏１５０度の加熱処理により共役化させ、被塗布領域に定着させて有機半導体膜４３を形成する。ここで、バンク層及び被塗布領域の大きさ及び形状は吐出される液体材料の液滴径３０μｍφに対して最適化された値に設定されているため、有機半導体膜４３の塗布領域はバンク層により確実に規定され、隣接する画素７にはみでることはない。しかも、バンク層は液体材料に対し非親和性を有し、被塗布領域が液体材料に対し親和性を有するため、液体材料がバンク側壁に付着することもない。この結果、熱処理後に形成される有機半導体膜４３は、各画素電極毎及び画素電極上で均一な厚みを保持する。

【０１１１】なお、有機半導体膜として、発光層、正孔注入層、電子注入層などを積層して形成する場合など多層構造素子を形成する場合には、インクジェット方式による液体材料の充填と乾燥を各層毎に繰り返せばよい。あるいは、正孔注入層、電子注入層がＲ，Ｇ，Ｂで共通の材料を使える場合には、スピンコート処理、ディップ処理においても液体材料の表面張力を３０ｄｙｎ／ｃｍ以下にして調整すれば画素領域にのみパターン形成することが可能である。具体例として有機ＥＬ素子に用いる正孔注入材料（例えば、ポリエチレンジオキシチオフェンなどのポリチオフェン誘導体）にポリスチレンスルフォン酸を添加したものの水分散液を表面張力の低い、セルソルブ系溶剤あるいはメタノールなどの表面張力の低いアルコール系あるいはその他の水溶系溶剤で希釈し、表面張力が３０ｄｙｎｅ／ｃｍ以下になるように調製した。

【０１１２】かかるスピンコート用溶液は、表面処理（プラズマ処理）したバンクに対して６０°以上、ＩＴＯ表面では２０°以上の接触角を示した。

【０１１３】有機半導体膜４３が形成されたら、透明基板１０のほぼ全面に対向電極ｏｐを形成してアクティブマトリクス型表示装置が完成する。

【０１１４】上記のような製造方法によれば、インクジェット法を利用して所定の領域にＲ，Ｇ，Ｂに対応する各有機半導体膜４３を形成できるので、フルカラーのアクティブマトリクス型表示装置を高い生産性で製造できる。しかも有機半導体膜を各画素毎に均一な厚みで形成できるので、明るさにむらが生じない。また、有機半導体膜の厚みが均一なので、薄膜発光素子４０の駆動電流が一部に集中することがなく、薄膜発光素子４０の信頼性の低下を防止できる。

【０１１５】なお、データ側駆動回路３や走査側駆動回路４にもＴＦＴが形成されるが、これらのＴＦＴは画素７にＴＦＴを形成していく工程の全部あるいは一部を採用して行われる。それ故、駆動回路を構成するＴＦＴも、画素７のＴＦＴと同一の層間に形成されることになる。また、第１のＴＦＴ２０、及び第２のＴＦＴ３０については、双方がＮ型、双方がＰ型、一方がＮ型で他方がＰ型のいずれでもよいが、このようないずれの組合せであっても周知の方法でＴＦＴを形成することができる。

【０１１６】（その他の変形例）なお、本発明は上記実施態様に限定されることなく、本発明の範囲内において、種々変更して実施することができる。

【０１１７】例えば、本発明はカラーフィルタに適用することができる。図６は本発明に適用したカラーフィルタの一例の断面図である。この場合、基板にガラスや石英からなる透明基板３００を、バンクとして樹脂等の黒色材料で形成した仕切部材３０１を、液体材料として着色樹脂３０２を使用する。仕切部材３０１としては、黒色顔料・染料や酸化クロム、クロム金属膜等を適用してブラックマトリクスを形成してもよい。透明基板３００上に仕切部材３０１を形成した後、インクジェット法により仕切部材３０１に囲まれた凹部被塗布領域３０３に着色樹脂３０２を充填する。その他、仕切り状の部材に囲まれた凹部に任意の流動体を充填して得られたもの、及びその製造方法であれば、本発明の適用は可能である。

【０１１８】具体例としてバンクの幅ａ及び被塗布領域の幅ｂを第１表に示すように変え、バンクの高さｃを２μｍとして図６に示すような表示装置を作製し、インクジェット法により液滴径ｄが３０μｍφの塗布液を用いて、被塗布領域に塗布した。結果を下記のような評価基準で評価し第１表に示す。但し、その他の条件は以下の

通りであった。
バンク材料：　ポリイミド（SiO_2＋ポリイミドの積層構造バンクでも良い。）
基板材料　：ＩＴＯ
バンク表面接触角：６０度（プラズマ処理）
被塗布領域接触角：１０度（プラズマ処理）
液体材料：ポリパラフェニレンビニレン前駆体溶液（ＰＰＶ前駆体をＤＭＦを主成分とする溶液に溶かし、グリセリン、ジエチレングリコールを少量添加し、インク化したもの）

評価基準

◎：　バンク上に残渣が残ることなく液滴は完全に凹部に収まる（図７Ｄ）Ｒ，Ｇ，Ｂの同時吐出が可能である。

【０１１９】

○：　液滴は凹部に収まるが、若干バンクに残渣が残る（図７Ｃ）

△：　液滴がバンク上に乗り上げてしまう。（図７Ｂ）乾燥後バンク上に材料が残る。Ｒ，Ｇ，Ｂの同時吐出は不可能である。

【０１２０】×：　液体材料が隣接する凹部に溢れ出す（図７Ａ）
ぬれが凹部に完全に広がらない（図７Ｅ）、ぬれが広がったとしても膜厚が薄いので数回の重ね打ちが必要となる。

【０１２１】
【表１】

		a（μm）			
		5	10	20	30
b μm	10	×	×	△	△
	15	×	○	○	○
	20	○	○	○	○
	30	◎	◎	◎	◎
	50	◎	◎	◎	◎
	160	×	×	×	×

以上、第１～第３の実施例およびその変形例に詳細に述べたように、インクジェット法においては、液体材料の液滴径に対するバンク及び被塗布領域の大きさを適性化することにより、画素間での混色がなく、画素毎の膜厚のばらつきの極めて少ない表示装置が得られる。また、Ｒ，Ｇ，Ｂの同時パターニングも可能となる。

【０１２２】また、スピンコート法やディッピング法においては、液体材料の表面張力を規定することにより、更に微細なパターニングが可能となる。

【０１２３】なお、本発明は、表示装置や表示装置以外であっても、これらに用いられる配線を有する基板に電子デバイス、例えばＴＦＴ素子の形成においても有効であるし、有機ＥＬ素子、表示装置あるいはカラーフィルタなどに有効に適用される。

【０１２４】続いて、特許請求の範囲の請求項３０～４８に記載の発明を実施した第４～第７の実施例およびその変形例を説明する。

【０１２５】（４）：　第４の実施例
本発明の第4の実施例は単一材料でバンクを形成した際の薄膜形成方法に関する。図８Ａ～８Ｄに本実施例の製造工程断面図を示す。本実施例はバンク形成面に任意の形状でバンクを設け、バンクで仕切られた領域に所定の流動体を充填するようなあらゆる用途に適用されるものである。例えば有機半導体薄膜素子を利用した表示素子で有機半導体材料を画素領域に充填する場合やカラーフィルタで着色樹脂を画素領域に充填する場合に適用可能である。

【０１２６】バンク形成工程（図８Ａ）：　バンク形成工程は、バンク形成面にバンクを形成する工程である。バンク形成面は、表示装置に使用する薄膜トランジスタ（ＴＦＴ：Thin Film Transistor）が形成された駆動基板であってもカラーフィルタに使用する透明基板であってもよい。仕切部材たるバンクで囲まれる領域に流動体を充填して薄膜を形成する目的であればバンク形成面の構造に限定はない。ただしバンクとの密着性の高い部材でその表面が形成されていることが好ましい。特に無機材料で構成されていることが後の表面処理で好適な親和性を得るために好ましい。表示装置であれば透明電極であるＩＴＯなど、カラーフィルタであればガラスや石英等で構成される。

【０１２７】バンクは仕切部材として機能する部材であり、例えばポリイミド等の絶縁有機材料で構成されていることが好ましく、その材料が絶縁性、半導体としての性質、導電性のいずれを有していてもよい。特に有機材料で構成されていることが後の表面処理で好適な非親和性を得るために好ましい。カラーフィルタ等では仕切部材は遮蔽機能を兼用させてもよい。遮蔽部材として形成するためには、ブラックマトリクス用の材料はクロム等の金属や酸化物を用いる。バンクの形成は、リソグラフィ法や印刷法等、任意の方法を選択できる。リソグラフィ法を使用する場合は、スピンコート、スプレーコード、ロールコート、ダイコート、ディップコート等所定の方法でバンクの高さに合わせて有機材料を塗布し、その上にレジスト層を塗布する。そしてバンク形状に合わせてマスクを施しレジストを露光・現像することによりバンク形状に合わせたレジストを残す。最後にエッチングしてマスク以外の部分のバンク材料を除去する。印刷法を使用する場合は、凹版、平版、凸版等任意の方法でバンク形状に有機材料を直接塗布する。バンク１１０の高さは、バンクで囲まれる凹部１０１に薄膜材料液を充填しても表面張力により隣接する凹部に薄膜材料液があふれ出ない程度の高さに形成する。例えば、加熱処理後の薄膜層２０４を０．０５μｍ～０．２μｍの厚みで形成するなら、バンク１１０を１μｍ～２μｍ程度の高さに形成する。

【０１２８】表面処理工程（図８Ｂ）：　表面処理工程は一定条件下でプラズマ処理を行ってバンク形成面１００とバンク１１０との薄膜材料液に対する親和性を調整する工程である。本発明のプラズマ処理では、導入ガスとしてフッ素を含むガスを用いる。減圧雰囲気下での減圧プラズマ処理であっても大気圧雰囲気下での大気圧プラズマ処理であってもよい。反応ガス中に一定量の酸素が含まれることが好ましい。フッ素系化合物としてはCF_4、SF_6、CHF_3等のハロゲンガスを用いる。

【０１２９】薄膜材料液等の任意の流動体に対して表面が濡れやすいや濡れ難いか、すなわち親和性を示すか非親和性を示すかは、材料表面の流動体に対する接触角を測定することで知ることができる。図９に、有機材料と無機材料とをプラズマ処理した際に、フッ素化合物と酸素との混合比によって接触角がどのようにして変わるかを測定した図を示す。この測定は、ポリイミド、ＩＴＯ、又はSiO_2を一面に形成した基板の表面に既述のプラズマ処理を施し、下記インクについての接触角を測定することにより行った。

【０１３０】ポリイミド膜を形成した基板については、ＰＰＶ前駆体インク（前駆体溶液をＤＭＦを主成分としグリセリン、ジエチレングリコールを少量添加し混合溶媒で希釈してインク化したもの）を用いた。

【０１３１】ＩＴＯ、又はSiO_2を形成した基板については、正孔注入材料（ポリエチレンジオキシチオフェンにポリスチレンスルフォン酸を添加したもの）の水分散液にメタノール、グリセリン、エトキシエタノールを添加し、インク化したものを用いた。

【０１３２】接触角はインク等の親水性のある流動体に対する接触角である。ここではフッ素系化合物としてCF_4を使用し、有機材料としてポリイミド、無機材料としてSiO_2とＩＴＯ（Indium-Tin- Oxide）を使用している。図９に示すように酸素が過多の雰囲気下では、有機材料、無機材料とも接触角の程度に大きな差異がない。ところがフッ素系化合物が過多にすると有機材料の接触角が大きくなる（非親和性になる）。これに対し無機材料の接触角の変化は小さい。酸素が反応ガスに含まれると酸素による酸化作用により無機材料および有機材料ともに極性基が発生する。しかしフッ素系化合物が過多であると有機材料中にフッ素化合物分子が入り込むようになるため、極性基の影響が相対的に少なくなると考えられる。したがってフッ素系化合物が酸素に比べ過多の条件で制御しながらプラズマ処理することにより、有機材料および無機材料それぞれを図９に従って所望の接触角（親和性）に設定することができる。特に図９の最良混合比（$CF_4/CF_4+O_2=75\%$）を使用したり大気圧中でCF_4とＨｅ混合ガスを導入したりすることは両者の接触角の差を最大とするために好ましい。

【０１３３】以上の事実より、フッ素系化合物を導入ガスとし一定の割合で酸素が混合されるように減圧プラズマ処理または大気圧プラズマ処理を行う。例えば図８Ｂに示すように、容量結合型のプラズマ処理では上記ガスを反応室に流し一方の電極上にバンク形成面１００を有する基板を載置し、他方の電極２０１との間に電源２００から電界を加える。反応室へのエネルギーの加え方には公知の方法、例えば直流法、高周波法、誘導結合形、容量結合形、マイクロ波法、電界と磁界とを供に加える方法等を種々に適用可能である。プラズマ処理によりそのフッ素系化合物と酸素との混合比により図９に従って任意の接触角にする表面処理が行われる。

【０１３４】当該表面処理により、バンク形成面１００（凹部１０１の底面）とバンク１１０との薄膜材料液に対する親和度が、「バンク形成面＞＞バンク表面」という順番になるように表面処理される。

【０１３５】薄膜形成工程（図８Ｃ、８Ｄ））：　薄膜形成工程はバンク１１０で囲まれた凹部１０１に薄膜材料液２０３を充填して薄膜層を形成する工程である。薄膜材料液２０３の充填後は加熱処理等により溶媒成分を蒸発させて薄膜層２０４を形成する。薄膜材料液を充填する方法としてはインクジェット方式によることが好ましい。インクジェット方式によれば任意の位置に任意の量で流動体を充填することができ、家庭用プリンタに使用されるような小型の装置で充填が可能だからである。

【０１３６】図８Ｃに示すように、インクジェット式記録ヘッド２０２から薄膜材料液２０３をバンク１１０で囲まれた凹部１０１に吐出する。吐出量は加熱処理により体積が減少した際に、所望の厚みになるような量とする。インクジェット式記録ヘッドから吐出させるには通常粘度が数ｐｃ以下である。表面処理によりバンク１１０の上面および側面は薄膜材料液２０３に対し適度な非親和性を示す。このため充填時には図８Ｄに示すように薄膜層２０４の厚さに比べて多量の薄膜材料液２０３を吐出しても、表面張力が作用して薄膜材料液２０３がバンク１１０を乗り越えることなく、Ｓ１の位置に盛り上がるほどに充填される。薄膜材料液を充填したら加熱処理等を行って溶媒成分を蒸発させる。溶媒成分が蒸発することにより、図８Ｄに示すように薄膜材料液２０３の体積が減少し、凹部１０１の底に薄膜層２０４が形成さ

れる。このときバンク形成面１００である凹部１０１の底は親和性を示すように表面処理されているので薄膜層２０４が好適に密着する。またバンク１１０の接触角を図９において極端に接触角が大きくならないように条件を選択しておけば、薄膜材料液２０３がバンク１１０の側壁で極端にはじかれることなくほぼ均一な膜厚で薄膜層２０４を形成できる。吐出される薄膜材料液２０３の盛は形成後の薄膜層２０４の厚みが例えば０．１μｍ～２μｍ程度になるように調整される。

【０１３７】なおインクジェット方式としてはピエゾジェット方式でも熱による気泡発生による吐出する方法であってもよい。ピエゾジェット方式では圧力室にノズルと圧電体素子とが備えられて構成されている。圧力室に流動体が充填されている圧電体素子に電圧を印加すると圧力室に体積変化が生じノズルから流動体の液滴が吐出される。気泡発生により吐出する方式では、ノズルに通ずる圧力室に発熱体が設けられている。発熱体を発熱させてノズル近辺の流動体を沸騰させ気泡を発生させてその体積膨張により流動体を吐出するものである。加熱による流動体の変質が無い点でピエゾジェット方式が好ましい。

【０１３８】上記したように本実施例によれば、フッ素系化合物に酸素が混入している条件でプラズマ処理を行うことにより、薄膜材料液に対しバンク表面を非親和性に、バンク形成面を親和性に一気に表面処理できる。しかも図９に示すような特性にしたがって親和性の度合いを示す接触角を容易に設定できる。すなわち、バンク自体はバンク形成面との高い密着性を保ちながら、親和性制御のために従来のように多数の工程を経ることなくバンクとバンク形成面との親和性を確実に制御することができる。これにより、薄膜材料液がバンクを超えて流れ出ることを防止し、歩留まりを向上させ、製造コストを減少させることができる。

【０１３９】（５）：　第5の実施例

本発明の第5の実施例は二層構造でバンクを形成した際の薄膜形成方法に関する。特に無機材料で下層を有機材料で上層を形成する点に特徴がある。

【０１４０】図１０Ａ～１０Ｆに本実施例の製造工程断面図を示す。本実施例は上記第4の実施例と同様に、バンク形成面に任意の形状でバンクを設け、バンクで仕切られた領域に所定の流動体を充填するようなあらゆる用途に適用されるものである。例えば有機半導体薄膜素子を利用した表示素子で有機半導体材料を画素領域に充填する場合やカラーフィルタで着色樹脂を画素領域に充填する場合に適用可能である。

【０１４１】下層膜形成工程（図１０Ａ）：　下層膜形成工程は、バンク形成面１００に下層膜１２０を形成する工程である。バンク形成面に関しては上記第4の実施例と同様である。下層膜の材料としては無機材料で構成されていることが後の表面処理で好適な非親和性を得るために好ましい。またバンク形成面１００と密着性のよい材料であることが好ましい。例えばバンク形成面がＩＴＯ等により形成されている場合、下層膜１２０に絶縁膜として一般的なシリコン酸化膜（SiO_2）やシリコン窒化膜、アモルファスシリコンを利用することが可能である。このような材料を使用した場合、プラズマ処理により凹部１０１の底面の親和性とバンク上層１２１の親和性との間の親和性が得られる。この親和性は薄膜材料液を平坦に凹部１０１底面に定着させるために有効である。下層膜の形成は、上記無機材料を例えばスピンコート、スプレーコード、ロールコート、ダイコート、ディップコート等所定の方法で所望の高さに合わせて塗布することによって行われる。下層膜１２０の高さは薄膜層２０４の高さにほぼ等しい程度が好ましい。下層膜１２０は薄膜材料液２０３とある程度の親和性があるため、薄膜材料液２０３が加熱処理される過程で下層膜１２０の壁面と薄膜材料液２０３とが密着する。最終的な薄膜材料液２０３の厚みと下層膜１２０の高さとをほぼ等しくしておけば、下層膜１２０の壁面に薄膜材料液２０３が密着することにより生ずる薄膜層２０４の表面のゆがみをなくすることができるからである。

【０１４２】上層形成工程（図１０Ｂ）：　上層形成工程は下層膜１２０の上にバンク上層１２１を形成する工程である。バンク上層１２１の材料としては上記第４の実施例で挙げた有機材料を使用する。遮蔽部材と兼用することも可能である。バンク上層１２１はバンクを形成したい領域に選択的に形成する。印刷法やリソグラフィ法等、任意の方法を選択できる。印刷法を使用する場合は、凹版、平版、凸版等任意の方法でバンク形状に有機材料を直接塗布する。リソグラフィ法を使用する場合は、スピンコート、スプレーコード、ロールコート、ダイコート、ディップコート等所定の方法でバンク上層１２１の高さに合わせて有機材料を塗布し、その上にレジスト層を塗布する。そしてバンク形状に合わせてマスクを施しレジストを露光・現像することによりバンク形状に合わせたレジストを残す。最後にエッチングしてマスク以外の部分のバンク上層の材料を除去する。バンク１１０の高さは、バンクで囲まれる凹部１０１に薄膜材料液を充填しても表面張力により隣接する凹部に薄膜材料液があふれ出ない程度の高さに形成する。例えば、加熱処理後の薄膜層２０４を０．０５μｍ～０．２μｍの厚みで形成するなら、下層膜１２０とバンク上層１２１との合わせた高さを１μｍ～２μｍ程度に形成する。

【０１４３】除去工程（図１０Ｃ）：　除去工程はバンク上層１２１をマスクとして下層膜１２０をエッチングする工程である。バンク上層１２１は有機材料であってレジストとして作用可能である。したがってエッチング材料を選択することにより下層膜１２０のみを選択的にエッチングすることができる。例えばバンク上層１２１を予め予定の厚みより厚く形成し、下層膜と一緒に全体をドライエッチングしたり、下層膜１２０がSiO_2で形成されている場合にはエッチング液にフッ酸を用いてウェットエッチングしたりする。この処理によりバンク上層１２１でマスクされているバンク形成領域以外の下層膜１２０が除去される。

【０１４４】表面処理工程（図１０Ｄ）：　表面処理工程は一定条件下でプラズマ処理を行ってバンク形成面１００と下層膜１２０およびバンク上層１２１の薄膜材料液に対する親和性を調整する工程である。本発明のプラズマ処理も上記実施形態１と同様の条件とガスによって行われる。特にバンク形成面１００と下層膜１２０とをそれぞれＩＴＯとSiO_2に選ぶと、この表面処理により好適な親和性設定が行える。すなわち図９に示すように、ＩＴＯとSiO_2はともに無機材料であるためフッ素系化合物と酸素の混合比による変化特性は類似するが、SiO_2の方が親和性の程度が高い傾向にある。このため上記表面処理により、バンク形成面１００、下層膜（バンク下層）１２０およびバンク上層１２１の親和性の程度を、「バンク形成面＞＝バンク下層表面＞バンク上層表面」という順番になるように表面処理することができる。

【０１４５】薄膜形成工程（図１０Ｅ，１０Ｆ）：　薄膜形成工程はバンク下層１２０および上層１２１で囲まれた凹部１０１に薄膜材料液２０３を充填して薄膜層を形成する工程である。その詳細は上記第4の実施例と同様である。薄膜材料液２０３の充填後は加熱処理等により溶媒成分を蒸発させて薄膜層２０４を形成する。

【０１４６】図１０Ｅに示すように、インクジェット式記録ヘッド２０２から薄膜材料液２０３をバンクで囲まれた凹部１０１に吐出する。吐出量は加熱処理により体積が減少した際に、所望の厚みになるような盛とする。この厚みは上記理由によりバンク下層１２０の厚みにほぼ等しいことが好ましい。充填時には図１０Ｅに示すように薄膜層２０４の厚さに比べて多量の薄膜材料液２０３を吐出しても、バンク上層１２１の表面張力が作用して薄膜材料液２０３がバンクを乗り越えることなく、Ｓ３の位置に盛り上がるほどに充填される。薄膜材料液を充填したら加熱処理等を行って溶媒成分を蒸発させる。溶媒成分が蒸発することにより、図１０Ｆに示すように薄膜材料液２０３の体積が減少し、凹部１０１の底の表面Ｓ４における厚みでバンク下層１２０と同程度の厚みの薄膜層２０４が形成される。このときバンク形成面１００である凹部１０１の底は親和性を示すように表面処理されているので薄膜層２０４が好適に濡れる。またバンク下層１２０の接触角はバンク上層１２１より小さく、適度な親和性で薄膜材料液２０３と密着する。このため薄膜材料液２０３がバンク下層１２０の側壁ではじかれることがない。またバンク下層１２０と薄膜層２０４とがほぼ同一の厚みなので、薄膜材料液２０３がバンク下層１２０の側壁に引きずられることがない。このためほぼ均一な膜厚で薄膜層２０４を形成できる。吐出される薄膜材料液２０３の盛は形成後の薄膜層２０４の厚みが例えば０．１μｍ～２μｍ程度になるように調整される。

【０１４７】上記したように本実施例によれば、無機材料と有機材料とを積層したバンクにフッ素系化合物に酸素が混入している条件でプラズマ処理を行うことにより、バンク上層、バンク下層およびバンク形成面の順で親和性が上がるように設定できる。すなわち、バンク自体はバンク形成面との高い密着性を保ちながら、親和性制御のために従来のように多数の工程を経ることなく簡単なプラズマ処理の制御により表面処理を一時に終了させることができる。これにより、薄膜材料液がバンクを超えて流れ出ることを防止し、歩留まりを向上させ、製造コストを減少させることができる。特に均一な薄膜層を形成できるという効果を奏する。

【０１４８】（６）：　第6の実施例

本発明の第６の実施例は上記第5の実施例とは異なる方法で二層構造でバンクを形成するものである。

【０１４９】図１１Ａ～１１Ｆおよび図１２Ａ～１２Ｃに本実施例の製造工程断面図を示す。本実施形態は上記第4の実施例と同様に、バンク形成面に任意の形状でバンクを設け、バンクで仕切られた領域に所定の流動体を充填するようなあらゆる用途に適用されるものである。例えば有機半導体薄膜素子を利用した表示素子で有機半導体材料を画素領域に充填する場合やカラーフィルタで着色樹脂を画素領域に充填する場合に適用可能である。バンク形成面、下層膜、バンク上層についての材料や厚みについては上記第４および第5の実施例と同様なので説明を省略する。

【０１５０】下層膜形成工程（図１１Ａ）：　下層膜形成工程は、バンク形成面１００に下層膜１３０を形成する工程である。上記第５の実施例と同様の方法により下層膜１３０を形成する。

【０１５１】露光工程（図１１Ｂ）：　露光工程は下層膜１３０をバンク形状に合わせて露光現像する工程である。下層膜１３０の上部にバンク形状に合わせてマスク１３２を設ける。下層膜１３０がエネルギー付与により硬化する材料の場合はバンク形成領域に光を透過させ、除去領域に光を透過させないようにマスクする。下層膜１３０がエネルギー付与により除去可能に変質する材料の場合はバンク形成領域の光を遮断し、除去領域に光を透過させるようにマスクする。本実施例ではバンク上層をマスクとして下層をエッチングするものではなく、下層と上層とを独立してエッチング可能なため、下層におけるバンク形状と上層におけるバンク形状とを異ならせることが可能である。このバンク下層の形状を適当なものに選ぶことにより、薄膜層を好適に設けることができるようになる。なお露光はレーザ光等のエネルギー線により公知の方法を用いて行う。

【０１５２】エッチング工程（図１１Ｃ）：　エッチング工程は、露光して硬化した領域を残して下層膜１３０を除去する工程である。露光後、マスクおよび除去領域の下層膜１３０を溶剤を用いて除去する。エッチングは、下層膜１３０としてＳｉＯ２やポリシラザンを用いた場合には、エッチング液としてフッ酸を用いる。またドライエッチングを用いてもよい。

【０１５３】上層膜形成工程（図１１Ｄ）：　上層膜形成工程は、バンク下層１３０を覆って上層膜１３０を形成する工程である。上記下層膜１３０と同様の方法により上層膜１３１を形成する。

【０１５４】露光工程（図１１Ｅ）：　露光工程は上層膜１３１を上層のバンク形状に合わせて露光する工程である。上層膜１３１上にバンク上層の形状に合わせてマスク１３４を設ける。上層膜１３１がエネルギー付与により硬化する材料の場合はバンク形成領域に光を透過させ、除去領域に光を透過させないようにマスクする。上層膜１３１がエネルギー付与により除去可能に変質する材料の場合はバンク形成領域の光を遮断し、除去領域に光を透過させるようにマスクする。上述したように本実施形態ではバンク上層１３１の形状を下層と異ならせてもよい。なお露光はレーザ光等のエネルギー源により公知の方法を用いて行う。

【０１５６】エッチング工程（図１１Ｆ）：　エッチング工程は、露光して硬化した領域を残して上層膜１３１を除去する工程である。露光後、マスクおよび除去領域の上層膜１３１を溶剤を用いて除去する。エッチングは、上層膜１３１としてポリイミドを用いた場合には、エッチング液としてフッ酸を用いる。またドライエッチングを用いてもよい。

【０１５６】表面処理工程（図１２Ａ）：　表面処理工程については上記第5の実施例と同様なので説明を省略する。この表面処理により、バンク形成面１００、バンク下層１３０およびバンク上層１３１の親和性の程度を、「バンク形成面＞＝バンク下層表面＞バンク上層表面」という順番になるように表面処理することができる。

【０１５７】薄膜形成工程（図１２Ｂ，１２Ｃ）：　薄膜形成工程はバンク下層１３０および上層１３１で囲まれた凹部１０１に薄膜材料液２０３を充填して薄膜層を形成する工程である。薄膜形成工程については上記第5の実施例と同様なので説明を省略する。

【０１５８】上記したように本実施例によれば、無機材料と有機材料とを積層したバンクにフッ素系化合物に酸素が混入している条件でプラズマ処理を行うことにより、バンク上層、バンク下層およびバンク形成面の順で親和性が上がるように設定できる。すなわち、バンク自体はバンク形成面との高い密着性を保ちながら、親和性制御のために従来のように多数の工程を経ることなく簡単なプラズマ処理の制御により表面処理を一時に終了させることができる。これにより、薄膜材料液がバンクを超えて流れ出ることを防止し、歩留まりを向上させ、製造コストを減少させることができる。特に均一な薄膜層を形成でき、かつバンク下層と上層とを異なる形状に形成できるという効果を奏する。

【０１５９】（７）：　第７の実施例

第7の実施例は、実際の表示装置に前述した第５の実施例を適用して製造された表示装置に関する。

【０１６０】（全体構成）この表示装置は、アクティブマトリクス型表示装置で成り、その全体構成は、前述した図３で説明したのと同一である（このため、構成要素の符号は、図３と同一のものを用い、その重複部分の説明を省略する）。図１３はそれに構成されている画素の１つを抜き出して示す平面図、図１４Ａ～１４Ｃはそれぞれ図１３の切断面Ａ－Ａ’における断面図、切断面Ｂ－Ｂ’における断面図、および切断面Ｃ－Ｃ’における断面図である。

【０１６１】このアクティブマトリクス型表示装置１は、その全体構成は前述した図３のものと同じまたは同等であるが、以下の点で相違する。

【０１６２】すなわち、各々の画素７は、バンク層ｂａｎｋで囲まれた凹部に形成されている。このバンク層は、下層側絶縁膜６１および上層側絶縁膜６２を積層して構成されている。このバンク層ｂａｎｋの製造に実施形態３が適用される。その材料や高さ等の条件については実施形態３と同様である。薄膜材料液としては、有機半導体材料が用いられる。この材料をバンク層ｂａｎｋで囲まれた領域に吐出し加熱することにより有機半導体膜４３が形成される。例えば、有機半導体膜４３が０．０５μｍ～０．２μｍであるなら、下層側絶縁膜６１と上層側絶縁膜６２とをそれぞれ０．２μｍ～１．０μｍ程度、１μｍ～２μｍ程度になるように形成される。

【０１６３】また、第１のＴＦＴ２０および第２のＴＦＴ３０は、図７および図８に示すように、島状の半導体膜により形成されている。有機半導体膜４３としては、電界の印加により発光する材料、例えばポリフェニレンビニレン（ＰＰＶ）が用いられる。

【０１６４】（バンク層の作用）上記構成において、バンク層ｂａｎｋは有機半導体材料２０３をインクジェット方式により充填する前に、上記実施形態と同様にフッ素またはフッ素化合物を導入ガスとしたプラズマ処理がされる。このため画素電極４１＞＝下層側絶縁層６２＞上層側絶縁層６２という順番で有機半導体材料に対する親和性が形成される。このため有機半導体材料を含んだ薄膜材料液をバンク層ｂａｎｋで囲まれた画素領域一杯に充填しても、下層側絶縁層６２の高さに有機半導体膜４３が落ち着き、有機半導体膜４３が凹字状に固化することを防止でき、平坦な有機半導体膜４３を形成することができる。有機半導体膜４３に膜厚の薄い部分があると、そこに薄膜発光素子４０の駆動電流が集中し、薄膜

発光素子４０の信頼性が低下することになるが、そのような問題を排除することができる。

【０１６５】また本実施例では、画素電極４１の形成領域のうち、導通制御回路５０の中継電極３５と重なる領域にもバンク層ｂａｎｋが形成され、中継電極３５と重なる領域には有機半導体膜４３が形成されていない。すなわち、画素電極４１の形成領域のうち、平坦な部分のみに有機半導体膜４３が形成される。これも有機半導体膜４３を一定の膜厚に維持する要因になっている。

【０１６６】さらに、中継電極３５と重なる領域にバンク層ｂａｎｋがないと、この部分でも対向電極ｏｐとの間に駆動電流が流れて有機半導体膜４３が発光する。しかしこの光は中継電極３５と対向電極ｏｐとの間に挟まれて外に出射されず表示に寄与しない。かかる表示に寄与しない部分で流れる駆動電流は、表示という面からみて無効電流といえる。しかるに本形態では、従来ならこのような無効電流が流れるはずの部分にバンク層ｂａｎｋを形成した。このため、共通給電線ｃｏｍに無駄な電流が流れることが防止でき、共通給電線ｃｏｍの幅はその分狭くてよくなる。その結果として、発光面積を増すことができ、輝度、コントラスト比などの表示性能を向上させることができる。

【０１６７】またインクジェット方式を用いることにより原色ごとに打ち分けて有機半導体膜を形成可能であるため、フォトリソグラフィ法などの複雑な工程を用いることなくパターニングが可能になる。

【０１６８】なお、バンク層ｂａｎｋを黒色のレジストによって形成してもよい。バンク層ｂａｎｋはブラックマトリクスとして機能し、コントラスト比などの表示品位が向上する。すなわち、本形態に係るアクティブマトリクス型表示装置１では、対向電極ｏｐが透明基板１０の表面側において画素７の全面に形成されるため、対向電極ｏｐでの反射光がコントラスト比を低下させる。しかるに寄生容量を少なくする機能を担うバンク層ｂａｎｋを黒色のレジストで構成すれば、バンク層ｂａｎｋをブラックマトリクスとして機能させることができ、対向電極ｏｐからの反射光を遮るので、コントラスト比を向上させることができる。

【０１６９】バンク層ｂａｎｋがデータ線ｓｉｇおよび走査線ｇａｔｅに沿って、有機半導体膜４１よりも厚く構成され、これに対向電極ｏｐが形成されている。したがってバンク層ｂａｎｋが存在することにより、データ線ｓｉｇには大きな容量が寄生することが防止される。すなわち、データ線ｓｉｇと対向電極ｏｐとの間にも、厚いバンク層ｂａｎｋが介在しているのでデータ線ｓｉｇに寄生する容量が極めて小さい。それ故、駆動回路３、４の負荷を低減でき、低消費電力化および／または表示動作の高速化を図ることができる。

【０１７０】またバンク層ｂａｎｋは無機材料および有機材料からなる二層構造で構成されている。無機材料のみで厚みの厚いバンク層を形成しようとすれば、長い時間をかけて無機材料からなる膜をＰＥＣＶＤ法などで成膜する必要がある。これに対しレジストやポリイミド膜等の有機材料は比較的厚い膜を形成するのが容易である。本実施形態のバンク層ｂａｎｋは上層側絶縁膜６２を厚膜化が容易な有機材料から構成しているので、バンク層形成が短時間で済むため生産性を高めることができる。

【０１７１】またかかる二層構造であれば、有機半導体膜４１は無機材料からなる下層側絶縁膜６１とは接しているが、有機材料からなる上層側絶縁膜６２とは接しない。それ故、有機半導体膜４１は有機材料から構成されている上層側絶縁膜６２の影響を受けて劣化することがないので、薄膜発光素子４０では、発光効率の低下や信頼性の低下が起きない。

【０１７２】また、本実施例によれば、透明基板１０の周辺領域（表示部１１の外側領域）にもバンク層ｂａｎｋが形成されているので、データ側駆動回路３および走査側駆動回路４もバンク層ｂａｎｋによって覆われている。対向電極ｏｐは、少なくとも表示部１１に形成されていれば十分であり、駆動回路領域にまで形成する必要がない。しかし対向電極ｏｐをマスクスパッタ法で形成した場合は合わせ精度が悪いため、駆動回路領域にまで対向電極ｏｐが形成されることがある。本実施例ではこれらの駆動回路領域にまで対向電極ｏｐが形成されたとしても、駆動回路の配線層と対向電極ｏｐとの間にバンク層ｂａｎｋが介在することになる。このため駆動回路３、４に容量が寄生することを防止できるため、駆動回路３、４の負荷を低減でき、低消費電力化および／または表示動作の高速化を図ることができる。

【０１７３】（表示装置の作用）上記のように構成したアクティブマトリクス型表示装置１において、走査信号によって選択されて第１のＴＦＴ２０がオン状態になると、データ線ｓｉｇからの画像信号が第１のＴＦＴ２０を介して第２のＴＦＴ３０のゲート電極３１に印加される。同時に画像信号が第１のＴＦＴ２０を介して保持容量ｃａｐに書き込まれる。その結果、第２のＴＦＴ３０がオン状態になると、対向電極ｏｐおよび画素電極４１をそれぞれ負極および正極として電圧が印加され、印加電圧がしきい値電圧を超えた領域で有機半導体膜４３に流れる電流（駆動電流）が急激に増大する。従って発光素子４０はエレクトロルミネッセンス素子あるいはＬＥＤ素子として発光する。発光素子４０の光は、対向電極ｏｐに反射されて透明な画素電極４１および透明基板１０を透過して射出される。このような発光を行うための駆動電流は、対向電極ｏｐ、有機半導体膜４３、画素電極４１、第２のＴＦＴ３０、および共通給電線ｃｏｍから構成される電流経路を流れるため、第２のＴＦＴ３０がオフ状態になると流れなくなる。但し第２のＴＦＴ３０のゲート電極は、第１のＴＦＴ２０がオフ状態になっ

ても、保持容量ｃａｐによって画像信号に相当する電位に保持されるので、第２のＴＦＴ３０はオン状態のままである。それ故、発光素子４０には駆動電流が流れ続け、この画素は点灯状態のままである。この状態は、新たな画像データが保持容量ｃａｐに書き込まれて、第２のＴＦＴ３０がオフ状態になるまで維持される。

【０１７４】（表示装置の製造方法）次に上記構成のアクティブマトリクス型表示装置の製造方法について図１５Ａ～１５Ｃ乃至図２０Ａ～２０Ｃを参照しながら説明する。本製造方法は表示装置に第5の実施例の製造方法を適用したものである。

【０１７５】半導体層形成工程（図１５Ａ～１５Ｃ）：まず、透明基板１０に対して、必要に応じて、ＴＥＯＳ（テトラエトキシシラン）や酸素ガスなどを原料ガスとしてプラズマＣＶＤ法により厚さが約２０００～５０００オングストロームのシリコン酸化膜からなる下地保護膜（図示せず。）を形成した後、下地保護膜の表面にプラズマＣＶＤ法により厚さが約３００～７００オングストロームのアモルファスのシリコン膜からなる半導体膜を形成する。次にアモルファスのシリコン膜からなる半導体膜に対して、レーザアニールまたは固相成長法などの結晶化工程を行い、半導体膜をポリシリコン膜に結晶化する。次に、半導体膜をパターニングして島状の半導体膜とし、その表面に対してＴＥＯＳ（テトラエトキシシラン）や酸素ガスなどを原料ガスとしてプラズマＣＶＤ法により厚さが約６００－１５００オングストロームのシリコン酸化膜または窒化膜からなるゲート絶縁膜３７を形成する。次に、アルミニウム、タンタル、モリブデン、チタン、タングステンなどの金属膜からなる導電膜をスパッタ法により形成した後パターニングし、ゲート電極２１、３１、およびゲート電極３１の延設部分３６を形成する。この工程では走査線ｇａｔｅも形成する。

【０１７６】この状態で、高濃度のリンイオンを打ち込んで、ゲート電極２１、３１に対して自己整合的にソース・ドレイン領域を形成する。なお不純物が導入されなかった部分がチャネル領域となる。次に、第１層間絶縁膜５１を形成した後、各コンタクトホールを形成し、データ線ｓｉｇ、ドレイン電極２２、共通給電線ｃｏｍ、共通給電線ｃｏｍの延設部分３９、および中継電極３５を形成する。その結果、第１のＴＦＴ２０、第２のＴＦＴ３０、および保持容量ｃａｐが形成される。

【０１７７】次に第２層間絶縁膜５２を形成し、この層間絶縁膜に中継電極３５に相当する部分にコンタクトホール形成する。次に第２層間絶縁膜５２の表面全体にＩＴＯ膜を形成した後パターニングし、コンタクトホールを介して第２のＴＦＴ３０のソース・ドレイン領域に電気的に接続して画素電極４１を画素７毎に形成する。

【０１７８】下層側絶縁膜形成工程（図１６Ａ～１６Ｃ）：次に、第２層間絶縁膜５２の表面側にＰＥＣＶＤ法などで無機材料からなる膜（下層側絶縁膜６１を形成するための無機膜）を形成する。この膜は上記実施形態で説明した無機材料および厚みで形成する。膜の厚みは有機半導体膜４１よりも厚く形成されている。例えば、有機半導体膜４１を０．０５μｍ～０．２μｍの厚みに形成するなら、無機材料の膜を０．２μｍ～１．０μｍ程度の厚みに形成する。

【０１７９】上層側絶縁膜形成工程（図１７Ａ～１７Ｃ）：次いで走査線ｇａｔｅおよびデータ線ｓｉｇに沿ってレジスト（上層側絶縁膜６２）を形成する。上層側絶縁膜６２は、上記実施形態の有機材料で構成する。上層側絶縁膜６２の厚みは、画素領域に薄膜材料液料を充填しても隣接する画素領域に薄膜材料液があふれ出ない程度の防波堤になりうる高さに形成する。例えば、有機半導体膜４１を０．０５μｍ～０．２μｍの厚みで形成するなら、上層側絶縁膜６２を１μｍ～２μｍ程度の高さに形成する。

【０１８０】除去工程（図１８Ａ～１８Ｃ）：次に、上層側絶縁膜６２をマスクとして無機材料から成る膜にパターニングを施す。その結果、無機材料からなる膜は走査線ｇａｔｅおよびデータ線ｓｉｇに沿って残り、下層側絶縁膜６１が形成される。このようにして下層側絶縁膜６１と上層側絶縁膜６２とからなる２層構造のバンク層ｂａｎｋが形成される。このときには、データ線ｓｉｇに沿って残すレジスト部分は共通給電線ｃｏｍを覆うように幅広とする。その結果、発光素子４０の有機半導体膜４３を形成すべき領域はバンク層ｂａｎｋに囲まれる。

【０１８１】表面処理工程（図１９Ａ～１９Ｃ）：次に画素電極４１の表面を薄膜材料液に対して親和性（薄膜材料液が水分を含むときは親水性）に、上層側絶縁膜６２を薄膜材料液に対して非親和性に、下層側絶縁膜６１をその間の親和性に設定するべくフッ素を使用してプラズマ処理を施す。具体的な方法は第４および第5の実施例と同様である。

【０１８２】以上により、画素電極４１、下層側絶縁膜６１（無機材料）および上層側絶縁膜６２（有機材料）の薄膜材料液に対する親和度が、「画素電極表面＞＝下層側絶縁膜表面＞上層側絶縁膜表面」という順番になるように表面処理される。

【０１８３】有機半導体膜形成工程（図２０Ａ～２０Ｃ）：上記表面処理が終わったら、バンク層ｂａｎｋでマトリクス状に区画された領域内にインクジェット法を利用してＲ、Ｇ、Ｂに対応する各有機半導体膜４３を形成していく。それには、バンク層ｂａｎｋの内側領域に対してインクジェット式記録ヘッド２０２から、有機半導体膜４３を構成するための液状の材料（前駆体／吐出液）である薄膜材料液２０３を吐出する。次いで１００℃～１５０℃の熱処理を施して薄膜材料液中の溶剤成分を蒸発させバンク層ｂａｎｋの内側領域で定着させて

有機半導体膜４３を形成する。ここでバンク層ｂａｎｋは上記表面処理がされているため撥水性を示す。これに対して有機半導体膜４３の前駆体である薄膜材料液は親水性の溶媒を用いているため、有機半導体膜４３の塗布領域はバンク層ｂａｎｋによって確実に規定され、隣接する画素７にはみ出ることがない。しかもバンク層ｂａｎｋの側壁も撥水性があるため熱処理で薄膜材料液の溶媒成分が蒸発していって薄膜材料液の嵩が減っていっても、薄膜材料液が側壁に付着することなく、より親水性を示す画素電極４１および無機材料の領域まで薄膜材料液と側壁との接触面が移動する。したがって熱処理後に形成される有機半導体膜４３は、周囲が厚くなることなく、画素電極上で均一な厚みを保持する。なお多層構造素子を形成する場合には、インクジェット方式による薄膜材料液の充填と乾燥とを各層ごとに繰り返していけばよい。例えば有機半導体層として、発光膜、正孔注入層、電子注入層などを積層して形成する場合である。

【０１８４】なお、上記工程において正孔輸送層をインクジェット方式で形成してもよい。例えば、正孔輸送層の元となる薄膜材料液をバンク層で囲まれた画素領域に３～４μｍの厚みで充填することができる。この薄膜材料液に熱処理を施すと、厚み０．０５μｍ～０．１μｍ程度の正孔輸送層を形成することができる。正孔輸送層が形成されたら、さらに再度インクジェット方式により上記した有機半導体材料を同様の厚みに充填する。

【０１８５】有機半導体層４３が形成されたら、透明基板１０の略全面に対向電極ｏｐを形成してアクティブマトリクス型表示装置１が完成する（図１４Ａ～１４Ｃ参照）。

【０１８６】上記のような製造方法によれば、インクジェット法を利用して所定の領域にＲ、Ｇ、Ｂに対応する各有機半導体膜４３を形成していけるので、フルカラーのアクティブマトリクス型表示装置１を高い生産性で製造できる。しかも有機半導体層を均一な厚みで形成できるので、明るさにムラが生じない。また、有機半導体膜の厚みが均一なので、薄膜発光素子４０の駆動電流が一部に集中することがないので、薄膜発光素子４０の信頼性が低下することを防止できる。

【０１８７】なお、図１３に示すデータ側駆動回路３や走査側駆動回路４にもＴＦＴが形成されるが、これらのＴＦＴは画素７にＴＦＴを形成していく工程の全部あるいは一部を援用して行われる。それ故、駆動回路を構成するＴＦＴも、画素７のＴＦＴと同一の層間に形成されることになる。また、第１のＴＦＴ２０、および第２のＴＦＴ３０については、双方がＮ型、双方がＰ型、一方がＮ型で他方がＰ型のいずれでもよいが、このようないずれの組合せであっても周知の方法でＴＦＴを形成していけるので、その説明を省略する。

【０１８８】（その他の変形例）なお、請求項３１～４９に記載の発明は上記第４～第７実施例に限定されることはなく、その発明の趣旨の範囲で種々に変更して適用することが可能である。

【０１８９】例えば第７の実施例は発明を表示装置に適用した具体例であったが、図２１に示すようにカラーフィルタに適用してもよい。この場合、バンク形成面としてガラスや石英からなる透明基板３００を、バンクとして樹脂等の黒色材料で形成した仕切部材３０１を、薄膜材料液として着色樹脂３０２を使用する。仕切部材３０１としては黒色顔料・染料や酸化クロム、クロム金属膜等を適用してブラックマトリクスを形成してもよい。透明基板３００上に仕切部材３０１を形成してからインクジェット方式により仕切部材３０１によって囲まれた凹部３０３に着色樹脂３０２を充填する。その他、仕切り状の部材に囲まれた凹部に任意の流動体を充填する製造方法であれば、かかる発明を適用可能である。

【０１９０】また表面処理はプラズマ処理に限られるものではなく、図９に示すように同一の表面処理条件下で異なる親和性に加工できる表面処理方法であれば適用が可能である。かかる発明の主旨は一回の表面加工により複数の親和性を一時に設定できる点にあるからである。したがって親和性を設定する材料は無機材料と有機材料との間に限られるものではなく、特定の材料間において図９に示す親和性の特性を示すものであれば、その特定材料間において、かかる発明の表面処理を適用可能である。

【０１９１】以上のように、第４～第７の実施例およびその変形例によれば、プラズマ処理を一定条件で管理したので、バンク自体はバンク形成面との高い密着性を保ちながら、親和性制御のために多数の工程を経ることなくバンクとバンク形成面との親和性を確実に制御することができる。これにより、歩留まりを向上させ、製造コストを減少させることができる。

【０１９２】また、表示装置によれば、プラズマ処理を一定条件で管理することでバンクとバンク形成面との親和性を確実に設定したので、薄膜材料液がバンクを超えて流れ出ることが防止でき、かつ均一な厚みの薄膜層を有する表示装置を提供できる。これにより、明るさや色にむらが生じない画像表示が行え、信頼性を向上させることができる。

【０１９３】さらに、薄膜材料液の充填をインクジェット方式で行えば、色彩の別に応じて薄膜層を打ち分けて形成できるので、フォトリソグラフィ法等にくらべパターニングに要する工程が少なくて済むという効果を奏する。続いて、特許請求の範囲の請求項４９～７４に記載の発明を実施した第８～第１１の実施例を図面に基づいて説明する。

【０１９４】（８）：第８の実施例

本発明の実施の形態１に係わる表面改質法について図面を用いて説明する。図２２は、酸素プラズマとCF_4プラズマ処理を続けて行った場合の、水系インク（表面張

力３０ｍＮ／ｍ）のＩＴＯ基板表面およびポリイミド膜表面上での接触角変化を示したものである。この測定は、ポリイミド、ＩＴＯを一面に形成した基板の表面に既述のプラズマ処理を施し、下記インクについての接触角を測定することにより行った。

【０１９５】ポリイミド膜、ＩＴＯを形成した基板については、正孔注入材料（ポリエチレンジオキシチオフェンにポリスチレンスルフォン酸を添加したもの）の水分散液にメタノール、グリセリン、エトキシエタノールを添加し、インク化したものを用いた。

【０１９６】酸素プラズマ処理は、酸素ガス流量が、５００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒで、CF_4プラズマ処理はCF_4ガス流量が、９００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒという条件で行った。

＊【０１９７】未処理の段階では、ＩＴＯ表面、ポリイミド表面ともむしろ撥水性を示すが、酸素プラズマ処理によりともに親水化され、さらにCF_4プラズマ処理によりＩＴＯ表面の親水性は保持されたまま、ポリイミド表面は撥水化されることがわかる。またガラス基板にを同様な処理をした場合、CF_4プラズマ処理後では２０～３０度の接触角を示した。

【０１９８】一般的に表面張力の低いキシレン等の有機溶剤系インクに対しても同様の連続プラズマ処理によりＩＴＯ表面上で１０度以下、ポリイミド表面上でも５０度の接触角を示した。

【０１９９】表２に、上記プラズマ処理を行ったポリイミド膜表面のＥＳＣＡ分析を行った結果を示す。

【０２００】

＊【表２】

	C(%)	N(%)	O(%)	F(%)
未処理	72.7	9.8	17.5	0
O2プラズマ	63.6	9.5	27	0
CF4プラズマ	33.3	3.1	6.8	51.8

表２から、酸素プラズマ処理により酸素原子が増え、CF_4プラズマ処理によりフッ素原子量が劇的に増加されフッ素化されることが明らかである。結合形態から、酸素プラズマ処理により一旦、－ＣＯＯＨ，－ＣＯＨが形成され、CF_4プラズマ処理によりテフロン化（$-CF_2-$）が起こっていることがわかった。

【０２０１】上記プラズマ処理によるテフロン化はアクリル骨格からなるネガレジストを用いた場合でも確認しており、フォトリソグラフィーによりパターン形成が可能な有機物の表面改質に大変有効である。

【０２０２】さらに大気圧下で、パワー３００Ｗ、電極－基板間距離１ｍｍ、酸素ガスプラズマは酸素ガス流量８０ｃｃｍ、ヘリウムガス流量１０ｌ／ｍｉｎ、搬送速度１０ｍｍ／ｓで、CF_4プラズマはCF_4ガス流量１００ｃｃｍ、ヘリウムガス流量１０ｌ／ｍｉｎ、搬送速度５ｍｍ／ｓの条件下で連続プラズマ処理を行った場合にも同様の結果を得ることができた。大気圧プラズマでは処理室内を真空にひく手間がなく簡便に同様の表面改質ができる点で大変有効である。

【０２０３】また、フッ素系ガスプラズマ処理を行う際に、CF_4ガスを用いた場合について説明したが、これに限らず、例えばNF_3、SF_6等のフッ素系ガスを用いることもできる。

【０２０４】濡れ性（表面エネルギー）は処理時間だけでなく、ガス流量、パワー、電極－基板間距離等のパラメーターにより制御可能である。

【０２０５】このように同じ酸素－CF_4連続プラズマ処理により無機物表面は親液性に、有機物表面は撥液性に表面改質することが可能である。

【０２０６】（９）：　第９の実施例

本発明の第９の実施例に係わる薄膜形成方法ならびに有機半導体薄膜を備えた有機ＥＬ素子の製造方法について図面を用いて説明する。

【０２０７】図２３Ａ～２３Ｂは有機ＥＬ素子の製造方法を示す工程断面図である。

【０２０８】図２３Ａに示す工程では、ＩＴＯ基板３０１上にポリイミドからなるバンク３０２をフォトリソ法により形成する。パターンはストライプであっても良いし、円形に抜けたパターンでも良い。バンクを形成する材料はポリイミドに限らずフォトリソ法によるパターン加工が可能な有機材料が使える。

【０２０９】図２３Ｂに示す工程では、酸素ガス流量が５００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒという条件で酸素プラズマ処理を１分行う。パワー３００Ｗ、電極－基板間距離１ｍｍ、酸素ガス流量８０ｃｃｍ、ヘリウムガス流量１０ｌ／ｍｉｎ、搬送速度１０ｍｍ／ｓで大気圧プラズマ処理を行っても良い。酸素プラズマ処理により親水性のＩＴＯ表面３ならびに活性化された（親水化された）ポリイミド層３０４が形成される。酸素プラズマ処理はＩＴＯ上のポリイミド残さをアッシングするという効果も有する。

【０２１０】続いて図２３Ｃに示す工程では、CF_4ガス流量が９００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒという条件でCF_4プラズマ処理を３０分行う。パワー３００Ｗ、電極－基板間距離１ｍｍ、CF_4ガス流量１００ｃｃｍ、ヘリウムガス流量１０ｌ／ｍｉｎ、搬送速度５ｍｍ／ｓの条件下で大気圧プラズマ処理を行ってもよい。親水性のＩＴＯ表面３０３を保持したままでポリイミド表面をテフロン化された撥液性表面３０５に改質することができる。

【０２１１】基板表面の汚染の程度が軽い場合は、酸素プラズマ処理を行わず、CF_4ガス流量が９００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒという条件でCF_4プラズマ処理を３０～６０分行っても同様の効果が得られた。

【０２１２】図２３Ｄに示す工程では、スピンコートにより正孔注入層３０６を形成する。正孔注入層材料液の表面張力を調節することによりＩＴＯ画素内だけに正孔注入層材料をパターニングすることができる。ポリエチレンジオキシチオフェンとポリスチレンスルフォン酸の水分散液をエトキシエタノール及びメタノール（合計７５パーセント）で希釈し、表面張力３０ｄｙｎｅ／ｃｍとしたものをスピンコート溶液として用いた。正孔注入層材料液に対し、プラズマ処理ＩＴＯ表面は、１０度以下の接触角を示すため均一に塗膜される。また、プラズマ処理ポリイミド表面では、６０度以上の接触角を示すためバンク上に塗膜されず、クロストークを起こすこともない。また、正孔注入層材料インクをインクジェット方式によりＩＴＯ画素内にパターニング成膜しても良い。インクジェット方式の法が材料を格段に節約することができる。

【０２１３】図２３Ｅでは、赤色発光層材料インク３０７、緑色発光層材料インク３０８、青色発光層材料インク３０９をそれぞれ所定の画素にインクジェットヘッド３１０より吐出することによりＲ，Ｇ，Ｂ，3色の発光層を形成する。緑色発光層材料には、ＰＰＶ前駆体用液をＤＭＦ、グリセリン、ジエチレングリコールの混合液で希釈してインク化したものを用いた。赤色発光層材料インクには、このＰＰＶを用いた緑色インクに赤色色素ローダミン１０１をＰＰＶに対して１．５ｗｔ％加えたインクを用いた。青色発光層材料インクには、ポリジオクチルスルフルオレンをキシレンに溶解したものをインクとして用いた。発光材料層インク３０７、３０８、３０９のプラズマ処理ポリイミド表面上での接触角は６０度以上であるため、混色の生じない高精細なパターニングが可能となる。モノクロ有機ＥＬ素子を形成する場合にはスピンコート法により発光層を形成しても良い。

【０２１４】また、前記プラズマ処理により正孔注入層材料液あるいは発光層インクとの接触角が２０度～３０度になるようなガラス層を下層にした２層からなるバンクを形成した基板を用いてもよい。バンク裾で短絡する恐れを回避することができる。

【０２１５】（１０）：　第１０の実施例

本発明の第１０の実施例に係わる薄膜形成方法ならびに着色薄膜を備えたカラーフィルターの製造方法について図面を用いて説明する。

【０２１６】図２４Ａ～２４Ｄはカラーフィルターの製造方法を示す工程断面図である。

【０２１７】図２４Ａに示す工程では、ガラス基板３１１上に樹脂ＢＭ（ブラックマトリックス）３１２をフォトリソ法により形成する。パターンはストライプであっても良いし、円形に抜けたパターンでも良い。

【０２１８】図２４Ｂに示す工程では、酸素ガス流量が５００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒという条件で酸素プラズマ処理を１分行う。パワー３００Ｗ、電極－基板間距離１ｍｍ、酸素ガス流量８０ｃｃｍ、ヘリウムガス流量１０ｌ／ｍｉｎ、搬送速度１０ｍｍ／ｓで大気圧プラズマ処理を行っても良い。酸素プラズマ処理により親水性のガラス表面１３ならびに活性化（親水化）された樹脂ＢＭ層３１４が形成される。酸素プラズマ処理はガラス上の樹脂残さをアッシングするという効果も有する。

【０２１９】続いて図２４Ｃに示す工程では、CF_4ガス流量が９００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒという条件でCF_4プラズマ処理を３０分行う。パワー３００Ｗ、電極－基板間距離１ｍｍ、CF_4ガス流量１００ｃｃｍ、ヘリウムガス流量１０ｌ／ｍｉｎ、搬送速度５ｍｍ／ｓの条件下で大気圧プラズマ処理を行ってもよい。親水性のガラス表面３１３を保持したままで樹脂ＢＭ表面をテフロン化された撥インク性表面３１５に改質することができる。

【０２２０】基板表面の汚染の程度が軽い場合は、酸素プラズマ処理を行わず、CF_4ガス流量が９００ＳＣＣＭ、パワー１．０Ｗ／ｃｍ^2、圧力１ｔｏｒｒという条件でCF_4プラズマ処理を３０～６０分行っても同様の効果が得られた。

【０２２１】図２４Ｄに示す工程では、赤色光透過顔料インク３１６、緑色光透過顔料インク３１７、青色光透過顔料インク３１８をそれぞれ所定の画素にインクジェットヘッド３１９より吐出することによりＲ，Ｇ，Ｂ，3色のフィルター層を形成する。顔料インク３１７、３１８、３１９のプラズマ処理樹脂ＢＭ表面上での接触角は６０度以上であるため、混色のない高精細なパターニングが可能となる。

【０２２２】また、前記プラズマ処理により顔料インクとの接触角が２０度～５０度になるような材料を下層にした２層からなるバンクを形成した基板を用いてもよい。色抜け膜厚むらの恐れを回避することができる。

【０２２３】（１１）：　第１１の実施例

本発明の第１１の実施例に係わる表面改質法ならびに薄膜形成法について図面を用いて説明する。

【０２２４】図２５Ａ～２５Ｄは、バンクを無機物および有機物の２層で形成した場合の効果を示した図である。

【０２２５】図２５Ａに示す工程では、ＩＴＯ基３板２０上に下層がガラス３２１、上層がポリイミド３２２からなる積層バンクをフォトリソ法により形成する。

【０２２６】図２５Ｂに示す工程では、第８～第１０の実施例で示したような酸素プラズマ、フッ素プラズマ処理を連続しておこなう。ＩＴＯ基板表面、バンク下層ガ

ラス表面は親水化され、バンク上層ポリイミドは撥液化される。

【０２２７】図２５Ｃに示す工程では、インクジェットヘッド３２６より薄膜材料インクＡ；３２７および薄膜材料インクＢ；３２８を吐出することにより隣接する凹部に異なる特性の薄膜材料液を塗布する。プラズマ処理後、薄膜材料インクに対するＩＴＯ表面３２３での接触角は２０度以下、バンク下層ガラス表面３２４では３０～４０度、バンク上層ポリイミド表面３２５では９０度の接触角を示す。

【０２２８】ベイク後、図２５Ｄに示すように、薄膜Ａ；３２９および薄膜Ｂ；３３０を得る。プラズマ処理ポリイミド表面３２５は強い撥インク性を示すため、図に示すようにポリイミドからなるバンク裾周辺では平坦に成膜されないことがある。しかし、ＩＴＯ表面３２３およびガラス表面３２４はともに親インク性のため、ガラスで形成された下層バンク裾周辺も成膜されＩＴＯ表面上では平坦な膜が形成される。有機ＥＬ素子などＩＴＯと電極で有機薄膜を挟む構造を有する素子の場合、ＩＴＯ上に膜が形成されていないために起こる短絡を防ぐことができる。また、カラーフィルターの製造においては膜厚ムラによる色ムラを防ぐために大変有効である。

【０２２９】以上のように、第８～第１１の実施例によれば、同一基板上に有機物で形成したバンクを有する基板に、酸素ガスプラズマ処理を行った後、これに続けてフッ素系ガスプラズマ処理を行うことで、基板表面の親液性を保持したままで、バンクに半永久的な撥液性を付与することができる。

【０２３０】また、上記方法によれば、簡便な方法で、同一基板上に表面エネルギーが制御されたパターンを形成することができ、従来のスピンコート等の塗布法だけでなく、インクジェット方式による塗膜方法で、薄膜材料液を精密にパターニング成膜することが可能となる。よってカラーフィルターやフルカラー有機ＥＬ装置の製造を混色、色ムラ、クロストークなく、低コストかつ簡便に製造することが可能となる。

【図面の簡単な説明】

【図１】図１は、本発明の表示装置と液滴の関係を示す概略説明図である。

【図２】図２Ａ～２Ｃは本発明の表示装置において、液滴溜を有するバンクの形状の例を示す断面図である。

【図３】図３は、本発明の表示装置に係るアクティブマトリクス型表示装置の一例の全体レイアウトを模式的に示すブロック図である。

【図４】図４は、図３に示すアクティブマトリクス型表示装置に構成される画素の一つを示す平面図である。

【図５】図５Ａ～５Ｃはそれぞれ図４のＡ－Ａ断面図，Ｂ－Ｂ断面図，Ｃ－Ｃ断面図である。

【図６】図６は、本発明を適用したカラーフィルタの一例の断面図である。

【図７】図７Ａ～７Ｅ参考実施例における各評価を示す断面図である。

【図８】図８Ａ～８Ｄは、本発明の第4の実施例に係る薄膜形成方法の製造工程断面図である。

【図９】図９は、本発明の表面処理の原理に係るフッ素系化合物と酸素との混合比と接触角との関係を説明する特性図である。

【図１０】図１０Ａ～１０Ｆは、本発明の第５の実施例に係る薄膜形成方法の製造工程断面図である。

【図１１】図１１Ａ～１１Ｆは、本発明の第６の実施形に係る薄膜形成方法の製造工程断面図である。

【図１２】図１２Ａ～１２Ｃは、本発明の第6の実施例に係る薄膜形成方法の製造工程断面図（続き）である。

【図１３】図１３は、本発明の第７の実施例に係るアクティブマトリクス型表示装置に構成されている画素の１つを抜き出して示す平面図である。

【図１４】図１４Ａ～１４Ｃは、図１３のＡ－Ａ’断面図、Ｂ－Ｂ’断面図、およびＣ－Ｃ’断面図である。

【図１５】図１５Ａ～１５Ｃは、半導体層形成工程を説明する、それぞれ図１３のＡ－Ａ’断面図、Ｂ－Ｂ’断面図、およびＣ－Ｃ’断面図である。

【図１６】図１６Ａ～１６Ｃは、下層側絶縁層形成工程を説明する、それぞれ図１３のＡ－Ａ’断面図、Ｂ－Ｂ’断面図、およびＣ－Ｃ’断面図である。

【図１７】図１７Ａ～１７Ｃは、上層側絶縁層形成工程を説明する、それぞれ図１３のＡ－Ａ’断面図、Ｂ－Ｂ’断面図、およびＣ－Ｃ’断面図である。

【図１８】図１８Ａ～１８Ｃは、バンク層形成工程を説明する、それぞれ図１３のＡ－Ａ’断面図、Ｂ－Ｂ’断面図、およびＣ－Ｃ’断面図である。

【図１９】図１９Ａ～１９Ｃは、表面処理工程を説明する、それぞれ図１３のＡ－Ａ’断面図、Ｂ－Ｂ’断面図、およびＣ－Ｃ’断面図である。

【図２０】図２０Ａ～２０Ｃは、有機半導体膜形成工程を説明する、それぞれ図１３のＡ－Ａ’断面図、Ｂ－Ｂ’断面図、およびＣ－Ｃ’断面図である。

【図２１】図２１は、本発明を適用したカラーフィルタの断面図である。

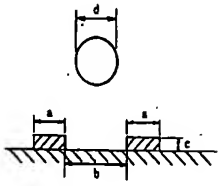
【図２２】図２２は、本発明の第８の実施例に係るプラズマ処理によるＩＴＯ基板表面およびポリイミド膜表面上での接触角変化を示す図である。

【図２３】図２３は、本発明の第９の実施例に係る有機ＥＬ素子の製造方法を示す工程断面図である。

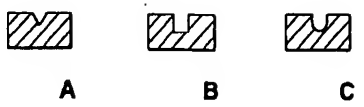
【図２４】図２４は、本発明の第１０の実施例に係るカラーフィルターの製造方法を示す工程断面図である。

【図２５】図２５は、本発明の第１１の実施例に係るバンクを無機物および有機物の２層で形成する製造方法を示す工程断面図である。

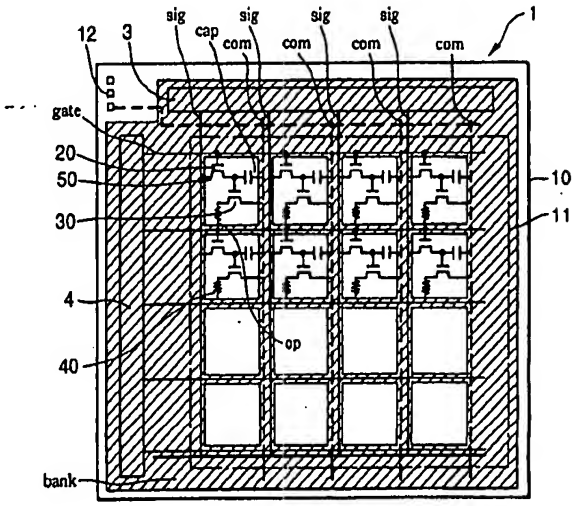
【図１】



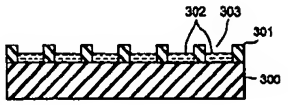
【図２】



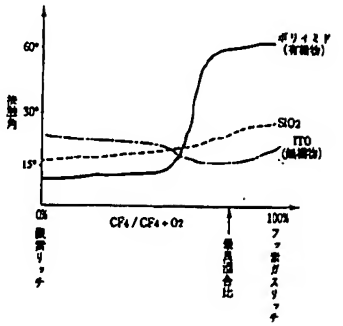
【図３】



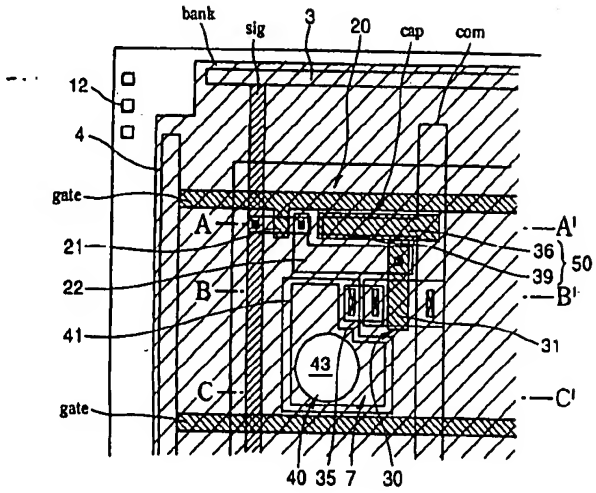
【図６】



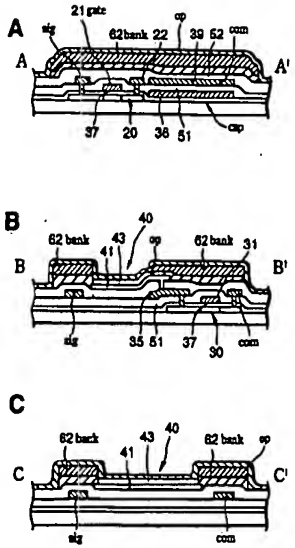
【図９】



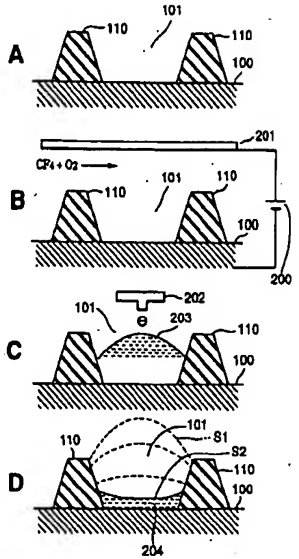
【図４】



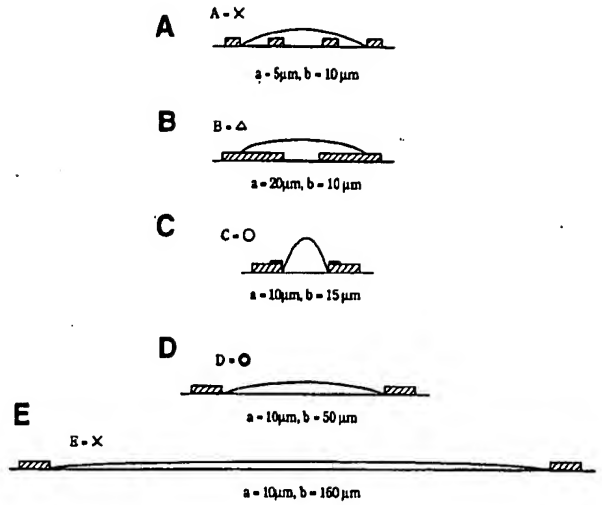
【図５】



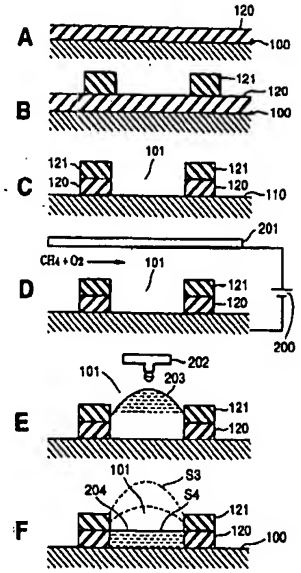
【図８】



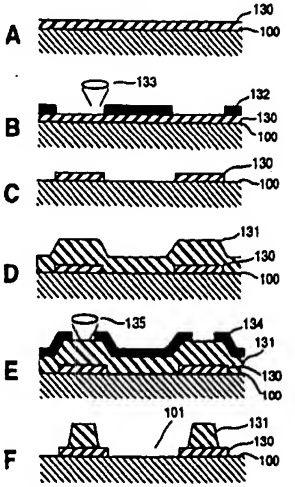
【図７】



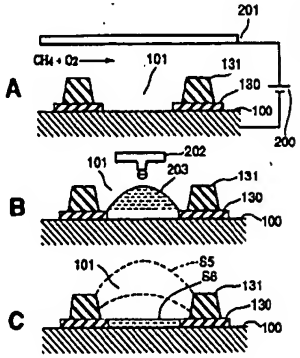
【図１０】



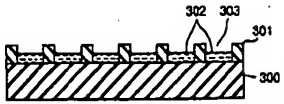
【図１１】



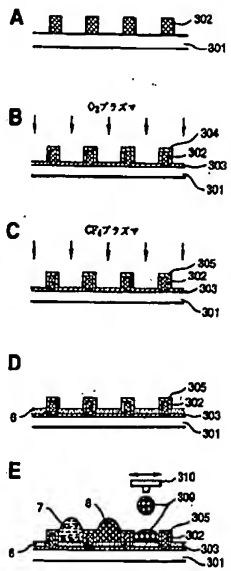
【図１２】



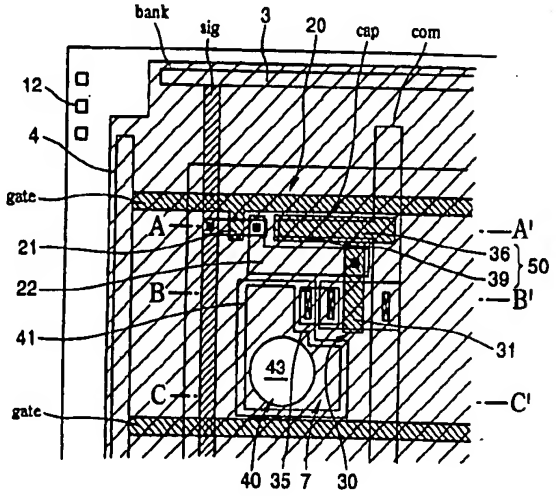
【図２１】



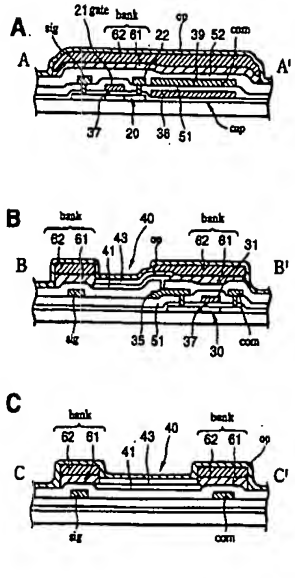
【図２３】



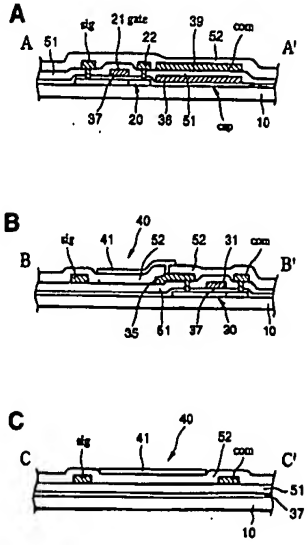
【図１３】



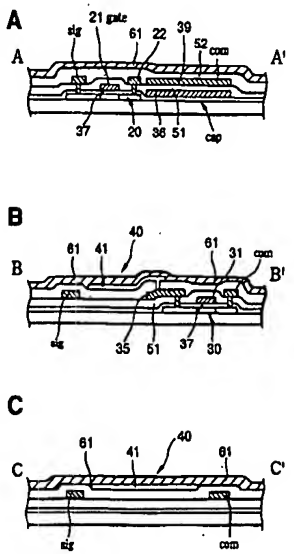
【図１４】



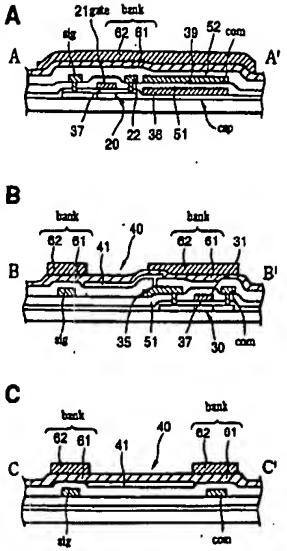
【図１５】



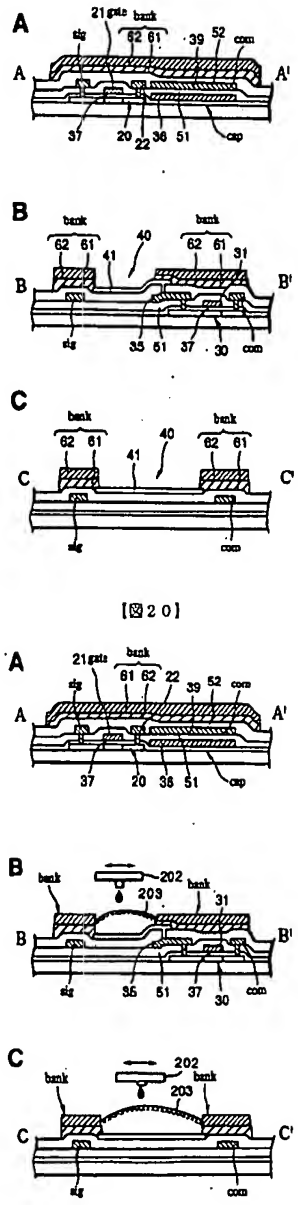
【図１６】



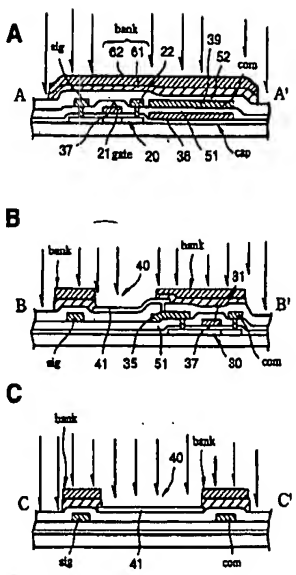
【図１７】



【図１８】

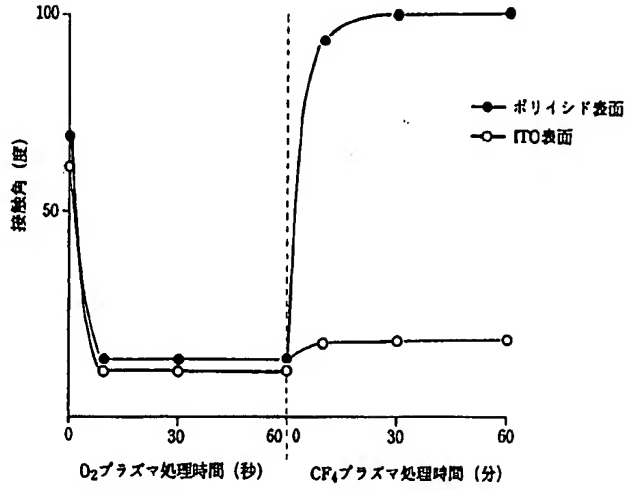


【図１９】

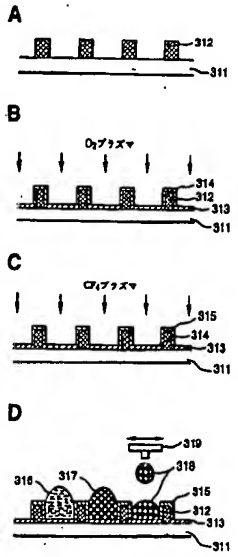


【図２０】

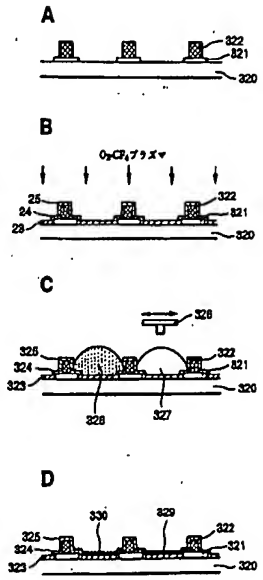
【図２２】



【図２４】



【図２５】



フロントページの続き

(51) Int. Cl.[7]		識別記号	F I		テーマコード（参考）
G09F	9/33		G09F	9/33	Z
H01L	33/00		H01L	33/00	M
H05B	33/10		H05B	33/10	
	33/12			33/12	B
	33/14			33/14	A

(72)発明者　湯田坂　一夫
長野県諏訪市大和三丁目３番５号　セイコーエプソン株式会社内

(72)発明者　宮島　弘夫
長野県諏訪市大和三丁目３番５号　セイコーエプソン株式会社内